General Electric Instrumentation
228 W. Florence
Inglewood, Calif. 90301

Instrumentation

Preliminary
Instruction Manual
for Model 8200

Universal Counter/Timer

SYSTRON DONNER
CORPORATION

General Electric Instrumentation
228 W. Florence
Inglewood, Calif. 90301

SYSTRON DONNER CORPORATION

INSTRUMENTATION

Manual Changes For

MODEL 8200 UNIVERSAL COUNTER/TIMER

Incorporate the following revisions to update your Model 8200 Instruction Manual.

Thru Revision E (April 1969)

General Electric Instrumentation
228 W. Florence
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Page 5-21, Figure 5-10.

Change to agree with attached page 5-21, Figure 5-10.

Page 5-24, Figure 5-13.

Delete " R2 "

Page 5-29, Figure 5-18.

Change "C1, 25 V" to C1, 4.7

Page 5-31, Figure 5-20.

Change "C18" located near C14 to C15.

Page 5-39, Figure 5-28.

Change "C9, 470" to C9, 470 pF.

Page 5-41, Figure 30.

Change "C6, 25 V, 47" to C6, 25 V, 4.7.

Page 5-43, Figure 5-32.

Change "R13, 56; R14, 56; R36, 56; R37, 56" to R13, 10; R14, 10; R36, 10; R37, 10.

Page 5-45, Figure 5-34.

Change "R7, 16 k" to R7, 1.6 k.

Change "½ Q5, FD1256" to ½ Q3, 2N3958.

Page 6-2, Table 6-1, lines 1 thru 3, 5 & 6, 8 thru 11 and 14.

Change	"92000108"	to	92000101
	"92000111"	to	92000102
	"92000109"	to	92000103
	"92000101"	to	92000105
	"92000102"	to	92000106
	"92000105"	to	92000108
	"92000103"	to	92000109
	"92000104"	to	92000110
	"92000112"	to	92000111
	"92000113"	to	92000114

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Thru Revision E (April 1969) (Continued)

Page 6-2, Table 6-1.

Add. Assembly, Card Extender ... 92000115.

Page 6-2, Table 6-1, line 8.

A8. Change "Ball" to Base

Page 6-2, Table 6-2, line 29.

J4. Change "64020261" to 64020461.

Page 6-2, Table 6-1, line 35.

J10. Change "21103180" to 81006020.

Page 6-3, Table 6-1, line 4.

Q4. Change "SE3030 ... 26003521" to SE3032 ... 26015191.

Page 6-4, Table 6-1, lines 2 thru 4.

Change "35071681" to 38020031
"38023680" to 38023770
"35071961" to 35071963.

Page 6-5, Table 6-2, line 3.

C3. Change "03287640" to 03287690.

Page 6-5, Table 6-2, line 8.

R1. Change "02380270" to 02381270.

Page 6-5, Table 6-2, line 11.

R4. Change "02373420" to 02373920.

Page 6-5, Table 6-2.

Add. C8 ... Capacitor, .01 μF ±20%, 100 V ... Sprague ... 03281960.

Page 6-6, Table 6-3, lines 15 and 16.

R8 Change "Amperex ... 02040771" to AB ... 02354900.

R9. Change "Amperex ... 02393481" to AB ... 02031050.

Thru Revision E (April 1969) (Continued)

Table 6-18, Table 6-7, lines 15 thru 17, and 19 thru 22, 24 thru 29.

Change "Amperex ... 02392621" to AB ... 02030190
"Amperex ... 02040311" to AB ... 02354450
"Amphenol ... 01095380" to Beckman ... 01111340

"±5%, ¼ W" to ±5%, 1 W

"Amperex ... 02040621" to AB ... 02354750
"Amperex ... 02040481" to AB ... 02354620
"Amperex... 02392591" to Beckman ... 02030160
"Amperex ... 02040641" to AB ... 02354770
"Amperex ... 02040241" to AB ... 02354380
"Amperex ... 02040541" to AB ... 02354670
"Amphenol ... 01095400" to Beckman ... 01111310
"Amperex ... 02040471" to AB ... 02354610
"Amperex ... 02040521" to AB ... 02354650.

Page 6-19, Table 6-7, lines 1, 2 and 3.

Change "Amperex ... 02040401" to AB ... 02354540.
"68 kΩ ... Amperex ... 02040681" to 6.8 kΩ ... AB ... 02354810.
"1.7 kΩ ... Amperex ... 02040581" to 2.7 kΩ ... AB ... 02354710.

Page 6-19, Table 6-7, lines 9 thru 12, 14 and 15.

Change "Amperex ... 02040721" to AB ... 02354850
"Amperex ... 02392671" to AB ... 02030240
"Amperex ... 02393031" to AB ... 02030600
"Amperex ... 02040761" to AB ... 02354890
"Amperex ... 02040661" to AB ... 02354790
"2 kΩ ... Amphenol ... 01095370" to 2 kΩ ±10%, ¾ W ... Beckman ... 01111090.

Page 6-20, Table 6-8, line 1.

C1. Change ".04 μF" to .047 μF.

Page 6-20, Table 6-8, line 29.

QA3. Change "MWμL911 ... 26012490" to μL911 ... 26011920.

Page 6-20, Table 6-8,line 34.

R1. Change "Amperex ... 02040771" to AB ... 02354900.

Page 6-21, Table 6-8, lines 6, 7 and 9.

Change "Amperex ... 02040841" to AB ... 02354970.
"Amperex ... 02040601" to AB ... 02354730
"Amperex ... 02040551" to AB ... 02354680

Thru Revision E (April 1969) (Continued)

Page 6-22, Table 6-9, lines 15, 18 thru 28, 33 & 34.

Change "26014011" to 26004011.

"Amperex ... 02040401"	to	AB ... 02354540
"Amperex ... 02040711"	to	AB ... 02354840
"Amperex ... 02040461"	to	AB ... 02354600
"Amperex ... 02040241"	to	AB ... 02354380
"Amperex ... 02040321"	to	AB ... 02354460
"Amperex ... 02040541"	to	AB ... 02354670
"Amperex ... 02040451"	to	AB ... 02354590
"Amperex ... 02040551"	to	AB ... 02354680
"Amperex ... 02040641"	to	AB ... 02354770
"Amperex ... 02040261"	to	AB ... 02354400
"Amperex ... 02040481"	to	AB ... 02354620
"Amperex ... 02040811"	to	AB ... 02354940
"Amperex ... 02040401"	to	AB ... 02354520

Page 6-23, Table 6-10, line 1.

C1. Change "250 V ..03281120" to 100 V ... 03285150.

Page 6-23, Table 6-10, line 5.

C5. Change "50 V" to 100 V.

Page 6-23, Table 6-10, line 15.

QA8. Change "26012490" to 26012410.

Page 6-23, Table 6-10, line 22.

QA15. Change "26012900" to 26011160.

Page 6-23, Table 6-10, line 27.

QA20. Change "MWμL911 ... 26012490" to μL911 ... 26011920.

Page 6-23, Table 6-10, lines 32 and 34.

Change

"Amperex ... 02040641"	to	AB ... 02354770
"Amperex ... 02040401"	to	AB ... 02354540.

Page 6-24, Table 6-10, lines 7 thru 10, 12, 13, 16 & 19.

Change

"Amperex ... 02040481"	to	AB ... 02354620
"Amperex ... 02040691"	to	AB ... 02354820
"Amperex ... 02040381"	to	AB ... 02354520
"Amperex ... 02040681"	to	AB ... 02354810
"Amperex ... 02392911"	to	AB ... 02030480
"Amperex ... 02040521"	to	AB ... 02354650
"Amperex ... 02040621"	to	AB ... 02354750
"Amperex ... 02040241"	to	AB ... 02354380

Thru Revision E (April 1969) (Continued)

Page 6-25, Table 6-11, line 10.

C10. Change "4.7 ΩF" to 4.7 μF.

Page 6-25, Table 6-11, line 11.

C11. Change "03287140" to 03287360.

Page 6-25, Table 6-11, lines 36, 38 and 39.

Change	"Amperex ... 02040581"	to	AB ... 02354710
	"Amperex ... 02040241"	to	AB ... 02354380
	"Amperex ... 02040841"	to	AB ... 02354970

Page 6-26, Table 6-11, lines 1, 3 thru 15.

Change	"Amperex ... 02040401"	to	AB ... 02354540
	"Amperex ... 02040521"	to	AB ... 02354650
	"Amperex ... 02040351"	to	AB ... 02354490
	"Amperex ... 02040551"	to	AB ... 02354680
	"Amperex ... 02040481"	to	AB ... 02354620
	"Amperex ... 02392981"	to	Amperex ... 02030550
	"Amperex ... 02040921"	to	AB ... 02355050
	"Amperex ... 02040721"	to	AB ... 02354850
	"Same as R16"	to	Same as R13
	"Amperex ... 02040761"	to	AB ... 02354890
	"Amperex ... 02040661"	to	AB ... 02354790
	"Amperex ... 02040881"	to	AB ... 02355010
	"Amperex ... 02040621"	to	AB ... 02354750
	"Amperex ... 02040701"	to	AB ... 02354830

Page 6-27, Table 6-12, lines 26, 36 thru 40.

Change	"FSC ... 02040551"	to	AB ... 02354680
	"Amperex ... 02040481"	to	AB ... 02354620
	"Amperex ... 02040571"	to	AB ... 02354700
	"Amperex ... 02040451"	to	AB ... 02354590
	"Amperex ... 02040461"	to	AB ... 02354600
	"Amperex ... 02040531"	to	AB ... 02354660

Page 6-28, Table 6-12, lines 1, 6 thru 9, 11, 12 and 14.

Change	"Amperex ... 02040641"	to	AB ... 02354770
	"Amperex ... 02040501"	to	AB ... 02354640
	"Amperex ... 02040171"	to	AB ... 02354310
	"Amperex ... 02040421"	to	AB ... 02354560
	"Amperex ... 02329931"	to	AB ... 02030500
	"Amperex ... 02040381"	to	AB ... 02354520
	"Amperex ... 02040741"	to	AB ... 02354870

"50 Ω ... Amperex ... 02040411" to 510 Ω ... AB ... 02354550

Thru Revision E (April 1969) (Continued)

Page 6-29 Table 6-13, lines 12, 38 and 39.

Change "26014011" to 26004011

"Amperex ... 02040481" to AB ... 02354620
"Amperex ... 02040631" to AB ... 02354760

Page 6-30, Table 6-13, lines 2, 4 thru 6, 9, 12, and 15 thru 17.

Change "Amperex ... 02040311" to AB ... 02354450
"Amperex ... 02040621" to AB ... 02354750
"Amperex ... 02040501" to AB ... 02354640
"Amperex ... 02040601" to AB ... 02354730
"56 Ω ... Amperex ... 02040181" to 10 Ω ... AB ... 02354140
"Amperex ... 02040381" to AB ... 02354520
"Amperex ... 02040741" to AB ... 02354870
"Amperex ... 02040841" to AB ... 02354970
"Same as R13" to Resistor, fixed, 56 Ω ±5%, ¼ W ... AB ... 02354320.

Page 6-30, Table 6-13.

Add. R44 ... Same as R1.
R45 ... Same as R1

Page 6-31, Table 6-14, lines 10, 12, 23, 25 and 32.

Change "26014011" to 26004011
"FD1256 ... 26004261" to 2N3958 ... 90000017.
"Amperex ... 02040411" to AB ... 02354550
"Amperex ... 02040961" to AB ... 02355090
2 k, 1 W ... 01095370" to 2 k, ¾ W ... 01111090

Page 6-32, Table 6-15, line 3.

R1. Change "Amperex ... 02040570" to AB ... 02354700.

Page 6-33, Table 6-16, lines 15, 24 thru 26.

Change "Amperex ... 02040771" to AB ... 02354900
"Amperex ... 02040841" to AB ... 02354970
"Amperex ... 02040551" to AB ... 02354680

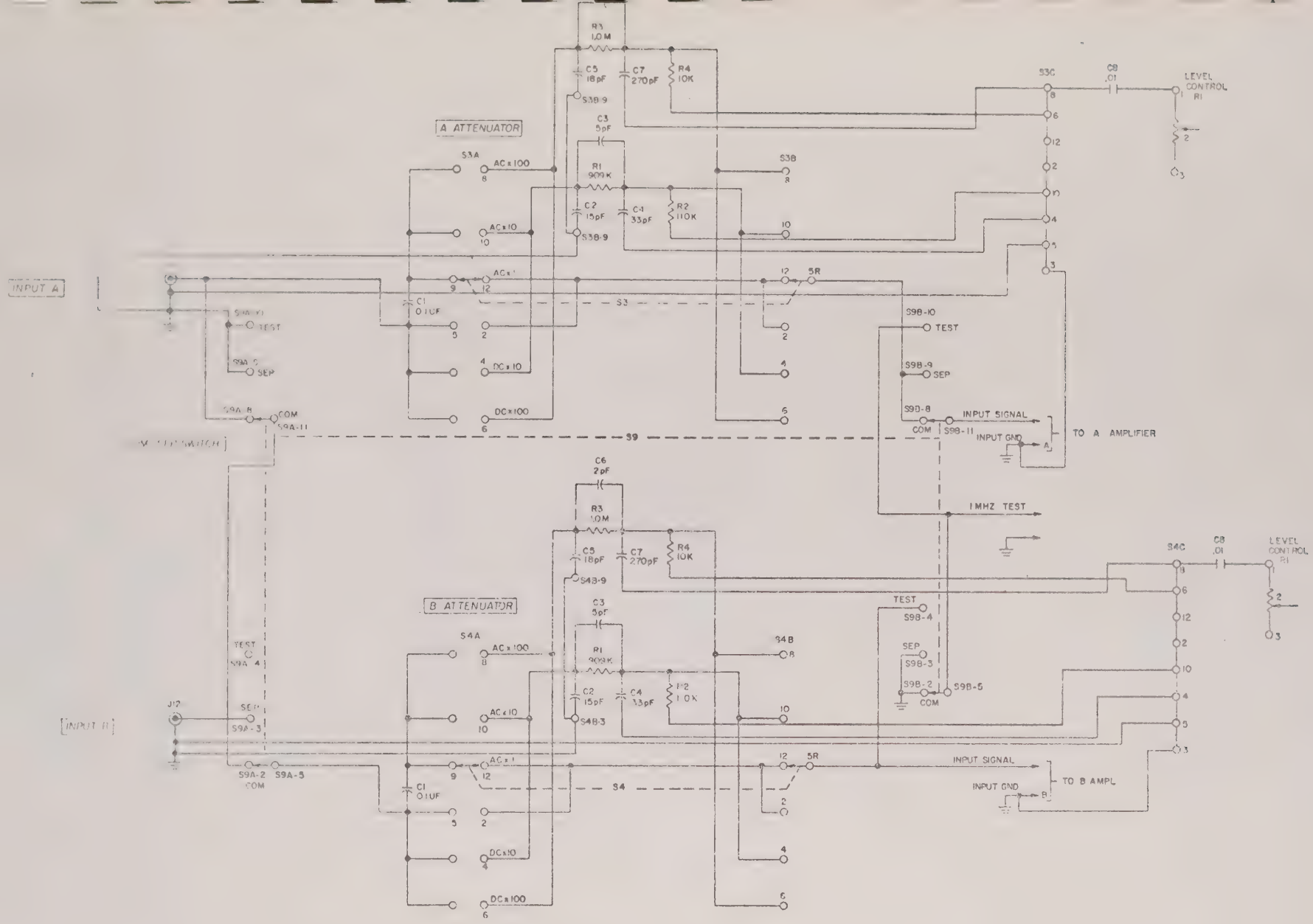

Figure 5-10. Schematic, Switches S3, S4, and S9

FEBRUARY 1968

Instrumentation

Preliminary Instruction Manual for Model 8200

LOOK FOR THE MEDALION

SYSTRON-DONNER CORPORATION recently acquired the DVM, Counter, and Curve Tracer instrument line of Fairchild Instrumentation, a division of Fairchild Camera and Instrument Corporation. These instruments are now being marketed under the SYSTRON-DONNER name. Please disregard all references to "FAIRCHILD" in this manual. Warranty provisions outlined herein, model numbers referred to, and replacement part numbers remain valid. Contact Systron-Donner Corporation for a listing of current sales representative organizations near you. Direct operating and/or service questions to:

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Universal Counter/Timer

SERIAL NUMBER

PART NUMBER 67051501

FAIRCHILD
INSTRUMENTATION

974 East Arques Ave., Sunnyvale, Calif. 94086
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EQUIPMENT WARRANTY

1. Seller warrants equipment of its manufacture against defective materials or workmanship for a period of one year from date of shipment.

2. The liability of Seller under this warranty is limited, at Seller's option, solely to repair, replacement with equivalent Fairchild equipment, at an appropriate credit adjustment not to exceed the original equipment sales price, of equipment returned to the Seller provided that (a) Seller is promptly notified in writing by Buyer upon discovery of defects, (b) upon receipt of written authorization from Seller the defective equipment is returned to Seller, transportation charges prepaid by Buyer, and, (c) Seller's examination of such equipment discloses to its satisfaction that defects were not caused by negligence, misuse, improper installation, accident, or unauthorized repair or alteration by the Buyer.

3. This warranty does not include mechanical parts failing from normal usage nor does it cover limited life electrical components which deteriorate with age such as vacuum tubes, choppers, lamps, etc. In the case of accessories, i.e., card punches, typewriters, etc., not manufactured by Seller, but which are furnished with the Seller's equipment, Seller's liability is limited to whatever warranty is extended by the manufacturers thereof and transferable to the Buyer.

4. This warranty is expressed in lieu of all other warranties, expressed or implied, including the implied warranty of fitness for a particular purpose, and of all other obligations or liabilities on the Seller's part, and it neither assumes nor authorizes any other person to assume for the Seller any other liabilities.

5. The aforementioned provisions do not extend the original warranty period of any article which has been either repaired or replaced by Seller.

Section I
General Information

1-1. INTRODUCTION

1-2. This manual contains information for operation, installation, and maintenance of the Fairchild Instrumentation Model 8200 Universal Counter Timer. Six sections are included in the manual. Section I gives a brief description of the instrument and its specifications with a detailed list of options. Section II contains information for installation. Section III provides operating instructions. Section IV discusses the theory of operation. Section V provides information on maintenance and troubleshooting. Section VI lists replacement parts and recommended spares.

1-3. DESCRIPTION

1-4. The Model 8200 is a universal, solid-state counter timer that employs a wide use of integrated circuits. The instrument accurately measures:

a. frequency of a signal in the range from 0 to 12.5 MHz,

b. period, or multiple period average, of a signal in the range from 0 to 2 MHz,

c. time interval between two selected points on a single signal or on two separate signals,

d. ratio or multiple ratio average of frequencies of two input signals, and

e. total number of signals or events in a manually controlled time interval.

1-5. Measurement accuracy is ensured by a temperature controlled 1 MHz crystal oscillator and the exclusive use of Fairchild Semiconductor integrated circuits in the time base generator and decade counters. The measurement is displayed on eight readout tubes—seven giving digit and decimal presentation and one giving unit of measurement. The readout circuitry provides variable display time from 0.1 to 5 seconds, or the reading can be held indefinitely.

1-6. The instrument provides standard output signals from 0.1 to 1.0 MHz in decade steps. A scaled input signal can be obtained from the instrument. The scaling factors, selected manually, are 1 through 10^7 in decade steps.

1-7. The major part of the circuitry is mounted on plug-in printed circuit boards. All components are enclosed in a single cabinet.

1-8. The Model 8200 provides space for external connection to an optional remote control programmer and a data logger. The remote control programmer is capable of programming all function modes except trigger level and display time. The measurement data is available for data logging in 1-2-4-8 binary coded decimal form. Information for these options is contained in separate manuals.

1-9. SPECIFICATIONS

1-10. Table 1-1 lists electrical specifications for the Model 8200 Universal Counter Timer.

1-11. DIMENSIONS AND WEIGHT

1-12. Figure 1-1 is an outline drawing of the Model 8200 that gives principal dimensions in inches and centimeters. The instrument's weight is 18 pounds (8.2 kg).

1-13. OPTIONAL EQUIPMENT AVAILABLE

1-14. The following options are available to increase the usefulness of the Model 8200:

OPTION 01: 4-line Binary coded decimal (1-2-4-8) Positive True Logic Output for a printer or a remote readout. Voltage levels are "0" level: more negative than 0.6 V; "1" level: more positive than 11.0 V. Source impedance: <30 kΩ each line. End-of-count signal: from more positive than +11.0 V to more negative than 0.6 V. Inverted signal line available. Signal source impedance: <30 kΩ.

OPTION 02: 4-line Binary coded decimal (1-2-4-8) Negative True Logic Output for a printer or a remote readout. Voltage levels are: "1" level: more negative than 0.6 V; "0" level: more positive than 11.0 V; Source impedance: <30 kΩ each line; End-of-count signal: from more positive than 11.0 V to more negative than 0.6 V; Inverted signal line available. Signal source impedance: <30 kΩ.

OPTION 03: Remote Control. All controls except TRIGGER level and DISPLAY TIME on front panel can be programmed by contact closures to ground.

OPTION 04: Rear Inputs. A and B channel BNC input connectors on rear panel. In parallel with front panel input connectors.

OPTION 05: High stability 1 MHz oscillator. Information not available at time of publication.

OPTION 06: Special Digital Outputs. Contact Fairchild Instrumentation for special code and voltage level requirements.

OPTION 07: Rack Mounting hardware without slides Fairchild Kit No. 35075831; with slides Fairchild Kit No. 35075821.

OPTION 08: Bench Handles. Fairchild Kit No. 35075841.

Table 1-1. Specifications

MEASUREMENTS PERFORMED	
	Frequency, Period, Multiple Period Average, Frequency Ratio, Multiple Ratio, Time Interval, Totalizing (Count).
INPUTS	
Channels:	A and B.
Frequency Range:	DC coupled, 0 to 12.5 MHz or to 2 MHz, depending on measurement function.. AC coupled, 10 Hz to 12.5 MHz or 10 Hz to 2.0 MHz.
Pulse Pair Resolution:	For pulses with 0.3 V amplitude, 50 nsec minimum width, minimum of 50 nsec pulse separation.
Sensitivity:	A) 0.1 V rms for sine-wave input. B) 0.3 V for positive or negative pulse input (50 nsec minimum width).
Maximum Input:	50 V rms without damage on 1 attenuator range, 500 V peak without damage all other ranges. Operating – 5 V rms.
Impedance:	Approximately 1 MΩ shunted by 50 pF.
Attenuation Factors:	1, 10 and 100.
Trigger Level:	±1 V, ±10 V and ±100 V continuously variable; trigger on positive or negative slope; separate control for each channel.
Channel Controls:	Separate inputs to channels A and B, common input to both channels, or 1 MHz test signal to both channels.
Connectors:	BNC connectors for both channels on front panel.
FREQUENCY MEASUREMENT	
Range:	0 to 12.5 MHz.
Input Channels:	A or B.
Units:	Hz, kHz, and MHz with automatically positioned decimal point.
Gate Times:	1 μsec to 10 sec in decade steps.
Accuracy:	±1 count ± time base accuracy.
Self Test:	Counts internal 1 MHz signal for gate times of 1 μsec to 10 seconds.

Table 1-1. Specifications (Continued)

FREQUENCY–RATIO MEASUREMENT

Frequency Range:	f_1 (channel A or B input): 0 to 12.5 MHz.
	f_2 (channel B or A input): 0 to 2 MHz.
Measures:	f_1/f_2 x multiplier.
Multipliers:	1 to 10^7 in decade steps.
Readout:	Reads f_1/f_2 with automatically positioned decimal point.
Accuracy:	±1 count of $f_1 \pm \frac{\text{trigger error of } f_2}{\text{multiplier setting}}$.*

TIME INTERVAL MEASUREMENT

(TIME A to B or B to A)

Input Channels:	A and B.
Range:	0.5 μsec to 10^7 seconds.
Time Base Frequency Counted:	10 MHz to 0.1 Hz in decade steps.
Accuracy:	±1 count ± time base accuracy ± trigger error of A and B.*
Units:	Ksec, sec, msec, or μsec with automatically positioned decimal point.
Self Test:	Measures period of internal 1 MHz signal.

* Trigger error decreases as signal amplitude and slope increases.

Trigger error is $\frac{\pm 0.0025\ \mu\text{sec}}{\text{signal slope (V/}\mu\text{sec)}}$. Below 0.1 Hz, maximum error may increase up to 10 times depending on line voltage and environment.

With trigger lever set at zero, either slope, trigger error for sine-wave is less than $\frac{(\pm 0.3\% \text{ of one period})}{\text{period averaged}}$ for signals with 40dB signal-to-noise ratio.

Table 1-1. Specifications (Continued)

PERIOD MEASUREMENT

Frequency Range:	0 to 2 MHz.
Input Channels:	A or B.
Units:	Ksec, sec, msec, and μsec with automatically positioned decimal point.
Time-base Frequency Counted:	10 MHz to 0.1 Hz in decade steps.
Accuracy:	±1 count ± time base accuracy ± trigger error.*
Self Test:	Measures period of internal 1 MHz signal.

MULTIPLE PERIOD AVERAGE MEASUREMENT

Frequency Range:	0 to 2 MHz.
Input Channels:	A or B.
Units:	μsec and nsec with automatically positioned decimal point.
Periods Averaged:	1 to 10^7 in decade steps.
Frequency Counted:	10 MHz
Accuracy:	±1 count ± time base accuracy ± $\frac{\text{trigger error}}{\text{periods averaged}}$*
Self Test:	Counts internal 1 MHz signal for gate time of 1 μsec to 10 sec in decade steps.

* Trigger error decreases as signal amplitude and slope increases.

Trigger error is $\frac{\pm 0.0025\ \mu\text{sec}}{\text{signal slope (V/}\mu\text{sec)}}$. Below 0.1 Hz, maximum error may increase up to 10 times depending on line voltage and environment.

With trigger lever set at zero, either slope, trigger error for sine-wave is less than $\frac{\pm 0.3\%\text{ of one period}}{\text{period averaged}}$ for signals with 40dB signal-to-noise ratio.

Table 1.1 Specifications (Continued)

TOTALIZING (COUNT)	
Maximum Count Display:	9,999,999.
Maximum Counting Rate:	12.5 MHz.
Input Channel:	A or B.
Start and Stop:	Selected by function switch.
Self Test:	Counts internal 1 MHz signal.
DISPLAY	
Number of Decades:	7 decades with automatically positioned decimal point.
Display Tubes:	8 in-line decimal display tubes.
Memory:	MEMORY switch in ON position selects storage of display count while next count is being accumulated. The display changes only when the new count changes. In the OFF position, the switch selects continuous display of counting.
Time:	Adjustable from less than 0.1 seconds to greater than 5.0 seconds, independent of gate time. DISPLAY TIME control also includes an INFINITE display time position.
Overflow Indicator:	Front panel lamp indicates when count exceeds 9,999,999.
Gate Indicator:	Front panel lamp indicates when count gate is open.
OUTPUT MARKERS	
	Approximately 12 V negative going pulses from a 1 kΩ source, approximately 10 μsec wide for oscilloscope Z axis modulation. Switch selects mixed or separate markers.
TIME BASE	
Source:	1 MHz internal crystal oscillator.
Stability as a function of	
Aging:	$<\pm 2$ parts in 10^7 / month.
Temperature:	$<\pm 3$ parts in 10^7 (0°C to +55°C).
Line Voltage:	$<\pm 1$ part 10^7 with line voltage change of ±10%.

Table 1-1. Specifications (Continued)

EXTERNAL CLOCK INPUT	
Frequency:	10 kHz to 2.0 MHz sine or square wave. Note: When using internal 10 MHz frequency multipliers, external clock input must be 1 MHz.
Amplitude:	0.5 V to 2.0 V rms operating, 10.0 V rms without damage.
Input Impedance:	>3 kΩ
SIGNAL OUTPUTS	
1 MHz	Approximately 2 V peak-to-peak; <1 kΩ source.
Time Base:	1 MHz to 0.1 Hz in decade steps; greater than 3.0 V peak-to-peak. Available at TIME BASE OUT jack in count function without reset interruptions.
Scaled A or B Signal:	A or B frequency (0 to 2.0 MHz) divided by 1 to 10^7 in decade steps; approximately 3.0 V peak-to-peak <5 kΩ source; (available at TIME BASE OUT jack. Use Per.Av. function, and display time on ∞).
Scaled External Clock:	Input divided by 1 to 10^7 in decade steps. Approximately 3.0 V peak-to-peak <5 kΩ source; available at TIME BASE OUT jack in count function without reset interruptions.
Trigger Outputs:	Front panel tip jacks provide shaped outputs from A and B input amplifiers.
MANUAL RESET	
	Pushbutton on front panel.
OPERATING TEMPERATURE RANGE	
	0°C to +40°C with fan off, 0 to +55°C with fan on. Switch for fan on rear panel.
POWER REQUIREMENTS	
	115/230 V ±10%. 50-400 Hz, (fan operates on 50-60 Hz only). 40 Watts.
ACCESSORIES PROVIDED	
	3 conductor ac power cord.
	2 coaxial cables, each four feet long, and each with male BNC connector on both ends.
	Board extractor.
	Extender board.

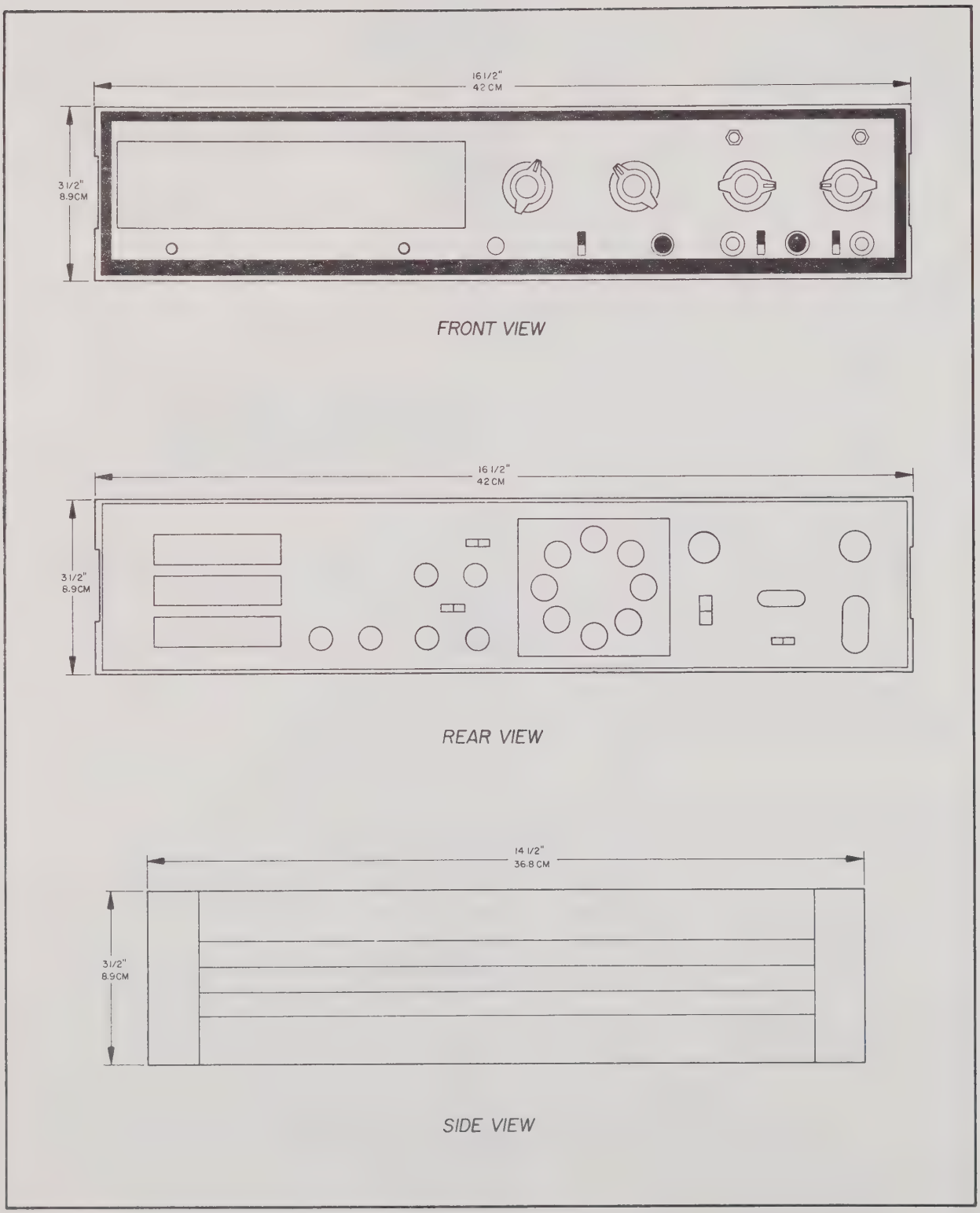


Figure 1-1. Model 8200 Outline Drawing

Section II
Installation

2-1. SCOPE OF SECTION

2-2. This section contains instructions for initial installation and inspection of the Model 8200. In addition, reshipment instructions are provided in the event that the unit must be returned to Fairchild Instrumentation.

2-3. UNPACKING AND INSPECTION

2-4. Before releasing the carrier, inspect the packaged unit for external damage. Any sign of external damage must be noted by both customer and shipper and called to the attention of the insurance investigator. Then, do not proceed with unpacking until instructed by the insuring agency.

2-5. MECHANICAL INSPECTION

2-6. Inspect the front panel for damage to knobs and connectors. Note any scratches or dents. Rotate the front panel controls through their complete range and note any sticking or binding. Examine the unit for damage to components, wiring or other internal damage.

2-7. POWER REQUIREMENTS

CAUTION

PRIMARY POWER AND CERTAIN DC VOLTAGES ARE PRESENT IN THE INTERIOR OF THE INSTRUMENT WHEN THE INSTRUMENT IS CONNECTED TO A SOURCE OF AC POWER AND THE FRONT PANEL POWER SWITCH IS SET TO OFF. DISCONNECT THE INSTRUMENT FROM AC POWER SOURCE TO REMOVE ALL POWER.

THE FAN OPERATES ON 50 TO 60 Hz ONLY. SET FAN SWITCH TO OFF WHEN FREQUENCY OF AC POWER SOURCE IS OTHER THAN 50 TO 60 Hz.

2-8. The Model 8200 operates from either a 115 V or 230 V ac, 3 wire, single phase, 50 to 400 Hz power source. A slide switch, labeled 115/230, located at the rear of the instrument, selects the appropriate input level. A 1 amp slow-blow fuse is required in holder F1 for 115 V operation and ½ amp slow-blow for 230 V. A ¼ amp slow-blow fuse is required in holder F2 for the 1 MHz oven.

2-9. POWER CABLE

2-10. The Model 8200 is supplied with a detachable 3-conductor power cable, terminated with a polarized 3-prong male connector at one end and a female connector at the other. The female connector fits the socket at the rear of the instrument. The center pin on the male connector grounds the chassis when the cable is connected to an appropriate receptacle.

2-11. To preserve the safety feature of the ground connection when the unit is operated from a 2-contact receptacle, use an adapter and connect the adapter pigtail to a suitable ground.

2-12. PERFORMANCE CHECK

2-13. The Model 8200 is completely aligned, calibrated, and checked before shipment and is ready for use upon receipt. A quick check to ensure that the unit is operating correctly and that it has suffered no damage in shipment may be made by carrying out the following steps:

a. Connect instrument to ac power source and depress power ON switch.

b. Set the following front panel controls:

COM-SEP switch to TEST
FUNCTION switch to FREQ.
TIME BASE switch to 1 S.

c. Observe readout. Reading should be 1,000,000 ±1 Hz.

2-14. A detailed alignment and checkout procedure is contained in Section V of this manual.

2-15. **RESHIPMENT**

2-16. When an instrument is damaged in shipment, do not return it to Fairchild Instrumentation without specific instructions from the insuring agency. Neither the customer nor Fairchild is required to assume such responsibility.

2-17. When an instrument is to be returned for service or repair, contact your nearest Fairchild Instrumentation engineering representative for shipping instructions.

2-18. **RACK MOUNT OPTION**

2-19. Instructions for mounting the optional rack-mounting accessory are not available at time of publication.

Section III
Operation

3-1. INTRODUCTION

3-2. This section describes controls and connectors on the Model 8200 and provides instructions for operating the instrument.

3-3. CONTROLS AND CONNECTORS

3-4. Figure 3-1 (in two parts) describes the controls and connectors on the front panel of the Model 8200. Rear panel controls and connectors are described in figure 3-2. Additional information on some of the controls is given in paragraphs 3-5 through 3-12.

3-5. **FUNCTION** switch.

a. Permits measurement of frequency in Hertz (cycles per second) of a periodic signal from channel A or from channel B when set to FREQ.

b. Permits measurement of the period (time per cycle) of a periodic signal from channel A or from channel B when set to PERIOD.

c. Permits measurement of the average of multiple periods when set to PER.AV. The multiplier is selected by the MULTIPLIER switch. A higher multiplier provides a more accurate measurement of periods.

d. Permits measurement of the frequency ratio or multiple ratio of A/B or B/A as selected by the A-B Reverse switch when set to RATIO.

e. Permits measurement of the time interval between triggering at channel A and triggering at channel B or vice versa when set to TIME. In frequency, period, period average, and frequency ratio measurements, changing the trigger point (determined by the slope and trigger level) along the signal or signals will not change the reading. However, measurement of time interval depends on the trigger points selected. Refer to the time chart in figure 4-14. In Case 1, a time interval between two points on two separate pulses is measured. Point A is selected by setting the SLOPE A switch to + and TRIGGER LEVEL A control to trigger level A; and point B is selected by setting SLOPE B switch to - and TRIGGER LEVEL B control to trigger level B. In Case 2, a time interval between two points on a periodic signal is measured, and points A and B are also selected by the SLOPE switches and TRIGGER LEVEL controls. For a periodic input signal, the sum of the time intervals from A→B and B→A should be equal to the period of that input signal. For an exact trigger point, use an oscilloscope and follow the instructions in paragraph 3-13.

3-6. TRIGGER LEVEL control and ATTENUATOR switch. The ATTENUATOR switch selects ac or dc coupling and attenuates an input signal by 1, 10, or 100 as shown on the scale. The TRIGGER LEVEL control selects the voltage level at which the input amplifier shaper triggers. When the amplitude of an input signal is known, refer to table 1-1, under the heading of INPUTS, for information to set the proper trigger level and attenuation for the input signal. When the amplitude of an input signal is not known, refer to paragraph 3-17 for triggering instructions. Use an oscilloscope as instructed in paragraph 3-13 to select an exact trigger point.

3-7. SLOPE switch. A positive (+) slope is a gradient on a signal going from a low to a high voltage level; a negative (-) slope is on a signal going from a high to a low voltage level. Note that there are two points at the same trigger level on a sinewave or a pulse. One point is on the positive slope and the other is on the negative slope. In time interval measurements, it is critical to select the proper slope for the trigger point.

3-8. TIME BASE/MULTIPLIER switch. The frequency of an input signal should be known before making measurements, other than frequency, to assist in determining the time base or multiplier settings. In period and time interval measurements, lower time base settings should be used for higher frequency signals. In period average and frequency ratio measurement, higher multipliers should be used for higher frequency signals. For frequency measurements, the time base can be manually extended to a multiple of 10 seconds by following the instructions in paragraph 3-16.

3-9. DISPLAY TIME control. DISPLAY TIME should be set to minimum at the beginning of a measuring process, so that a fast sampling of the reading is obtained while the operator is selecting the proper time base/multiplier or the trigger level.

3-10. Readout unit. When the readout reads zero ±1 count, change the trigger level, or time base/multiplier setting to obtain a reading. When the reading is overrange (OVER FLOW indicator lights) change time base/multiplier setting to obtain a measurement. The OVER FLOW light can be used to obtain a reading of greater than seven digits. First obtain a seven digit reading without overflow. Then change the time base/multiplier setting to next position to obtain the reading with overflow. The last digit is the eighth digit of the measurement. If the time base/multiplier is switched down one more position, the last digit is the ninth digit. Other digits of higher order are obtained in the same manner.

3-11. TIME BASE OUT connector. The connector is connected directly to the output of the decade dividers in the time base circuit. In frequency, period, and time interval measurements, its output is the time base/multiplier as selected by the TIME BASE switch when the display time is set to ∞. For example, if the TIME BASE switch is set on 10 msec, the signal from the connector is a rectangular wave with 10 msec period or 100 Hz. In ratio and period average measurements, the connector output is the scaled input signal when the display time is set to ∞. The scaling factor is selected by the MULTIPLIER switch. For example, if the input signal is 1.2 kHz and MULTIPLIER switch is on 10^3, the signal from the connector is 1.2 Hz.

3-12. MARKER A and MARKER B connectors. The marker pulses are negative 10 μsec pulses from the corresponding channel. The low-going edge of a 10 μsec pulse is coincident with the triggering of an input signal. Therefore, the marker pulses have the same frequency as the input signal.

3-13. **TRIGGER POINT SELECTION**

3-14. To select trigger point, proceed as follows:

a. Connect the signal being measured to an oscilloscope.

b. Connect the MARKER OUT on the rear panel to the z-input of the oscilloscope.

c. The trigger point on the signal is blanked on a Fairchild oscilloscope and is intensified on other manufacturers' oscilloscopes. Vary the TRIGGER LEVEL control to move the trigger point up or down on the signal.

3-15. **TIME BASE EXTENSION**

3-16. To extend the time base manually, proceed as follows:

a. Set DISPLAY TIME control to ∞.

b. Set TIME BASE switch to 10 sec.

c. Set FUNCTION switch to FREQ.

d. Within 10 sec set FUNCTION switch to START.

e. After a multiple, M, of 10 sec, set FUNCTION switch back to FREQ. The time base then is extended to (M+1) x 10 sec.

f. Divide the reading by (M+1) to obtain the correct measurement. For example, if (M+1) is 4 and reading is 412 Hz, the frequency is 103 Hz.

3-17. **PROCEDURE TO OBTAIN TRIGGERING**

3-18. To obtain triggering of an unknown signal (at either channel) proceed as follows:

a. Set DISPLAY TIME control to minimum display time.

b. Set A-B Reverse switch to A (or B).

c. Set COM-SEP switch to SEP.

d. Set ATTENUATOR switch to X100 AC.

g. Set FUNCTION switch to START.

6. Connect the unknown signal to INPUT A connector (or INPUT B connector).

7. Vary TRIGGER LEVEL control in both directions for a continuous reading.

8. If no continuous counts are observed, set ATTENUATOR switch to X10 AC.

9. Vary TRIGGER LEVEL control in both direction for continuous counts.

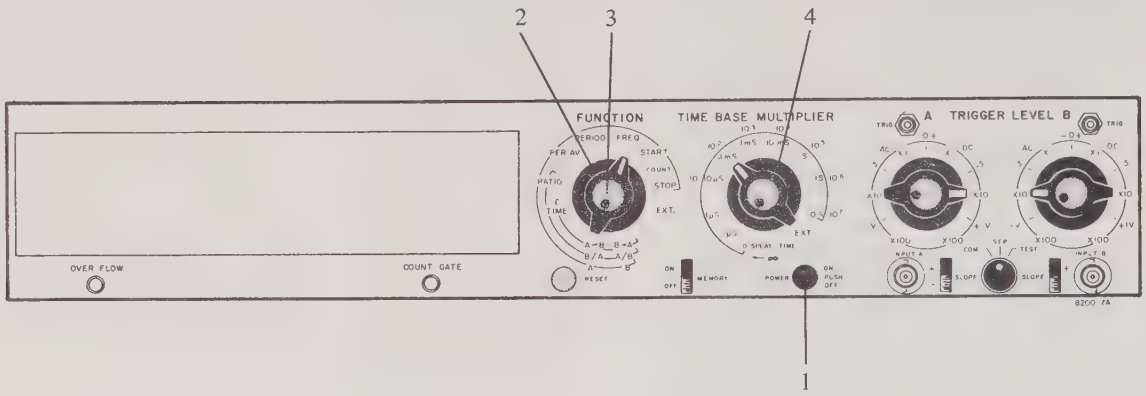
10. If no continuous counts are observed, set ATTENUATOR switch to X1 AC.

11. Vary TRIGGER LEVEL control in both directions for continuous counts.

12. If no continuous counts are observed, the unknown must be less than 100 mV rms which is the minimum level the instrument can measure.

3-19. OPERATING INSTRUCTIONS

3-20. Apply power to the instrument at MAIN POWER receptacle on the rear panel. This energizes the 1 MHz oscillator. Switch the POWER switch on the front panel to ON. For each mode of operation, proceed as instructed in figures 3-3 through 3-8.



1. POWER pushbutton switches primary power to instrument.

NOTE

1 MHz oscillator is connected directly to the power line.

2. FUNCTION switch:

   a) Connects function select signals from the optional remote control programer to the instrument when switched to EXT.

   b) Generates a "start counting" command on count mode when switched to START.

   c) Generates a "stop counting" command on count mode when switched to STOP.

   d) Selects frequency measuring mode when switched to FREQ.

   e) Selects period measuring mode when switched to PERIOD.

   f) Selects period average mode when switched to PER.AV.

   g) Selects frequency ratio measuring mode when switched to RATIO.

   h) Selects time interval measuring mode when switched to TIME.

3. A-B REVERSE switch:

   a) Measures time interval between triggering of channel A and triggering of channel B when switched to A→B (time mode).

   b) Measures ratio of frequency at INPUT A to frequency at INPUT B when switched to A/B (ratio mode).

   c) Measures signal at INPUT A when switched to A (count, frequency, period, time, and period average modes).

   d) Measures time interval between triggering of channel B and triggering of channel A when switched to B→A (time mode).

   e) Measures ratio of frequency at INPUT B to frequency at INPUT A when switched to B/A (ratio mode).

   f) Measures signal at INPUT B when switched to B (count, frequency, time, and period average modes).

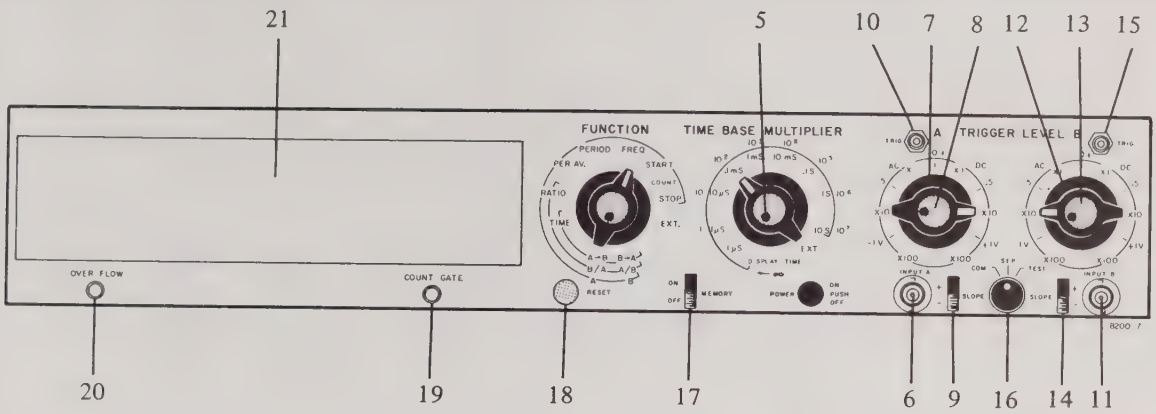
4. TIME BASE/MULTIPLIER switch:

   a) Connects time base/multiplier select signals from the optional remote control programer to instrument when switched to EXT.

   b) Selects time base for frequency, period, and time interval measurements when switched to TIME BASE setting (black scale).

   c) Selects number of periods averaged for period average and ratio measurements when switched to MULTIPLIER settings (blue scale).

Figure 3-1. Front Panel Description

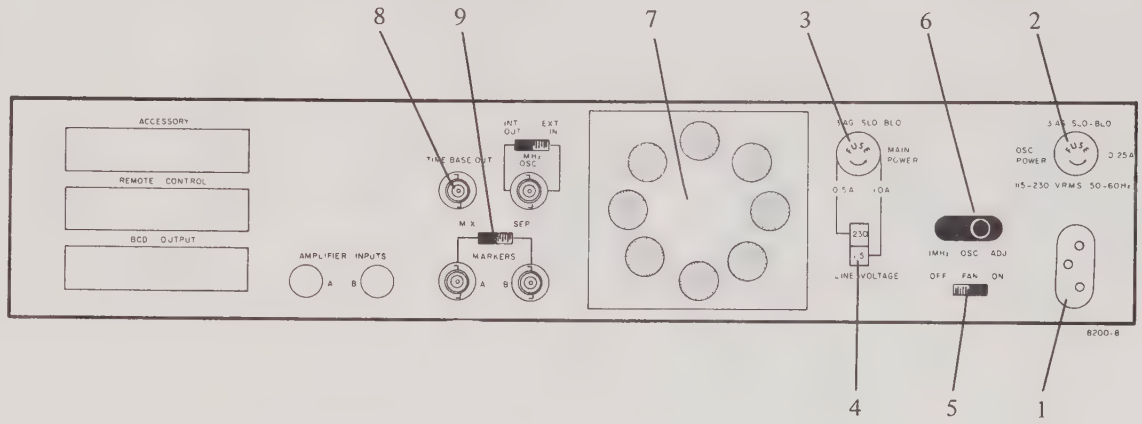


5. DISPLAY TIME control:
   a) Permits variable display time from 0.1 to 5 seconds.
   b) Permits infinite display time when switched to ∞.
6. INPUT A connector couples input signal to channel A.
7. ATTENUATOR A switch selects ac or dc mode and attenuation of signal applied at INPUT A (black scale).
8. TRIGGER LEVEL A control selects trigger level from -1 V to +1 V (red scale).
9. INPUT A SLOPE switch:
   a) Selects positive slope trigger for channel A when set to +.
   b) Selects negative slope trigger for channel B when set to -.
10. TRIG A jack monitors channel A trigger pulses.
11. INPUT B connector couples input signal to channel B.
12. ATTENUATOR B switch selects ac or dc mode and attenuation of signal applied at INPUT B (black scale).
13. TRIGGER LEVEL B control selects trigger level from -1 V to +1 V (red scale).
14. INPUT B SLOPE switch:
   a) Selects positive slope trigger for channel B when set to +.
   b) Selects negative slope trigger for channel B when set to -.
15. TRIG B jack monitors channel B trigger pulses.
16. COM-SEP switch:
   a) Connects signal applied at INPUT A connector to both channels A and B when switched to COM.
   b) Connects signal applied at INPUT A to channel A and signal applied at INPUT B to channel B when switched to SEP.
   c) Connects internal 1 MHz signal to channel A and channel B when switched to TEST.
17. MEMORY switch controls operation of digital readout. Readout changes to most recent reading at end of count when switched to ON; Readout displays instantaneous reading when switched to OFF.
18. RESET pushbutton resets decade counters and readout display to zero.
19. OVERFLOW indicator lights when over range occurs.
20. COUNT GATE indicator lights when count gate is open.
21. Readout display has seven digits with automated decimal point placement and measurement unit display. The units are: MHz, kHz, Hz, ksec, sec, msec, μsec, nsec and *.

NOTE

Do not use the 0.1 μsec time base for RATIO, PER.AV., and FREQ. modes of operation. If this condition is selected, no reading occurs, and an * appears in the unit window.

Figure 3-1. Front Panel Description (Continued)

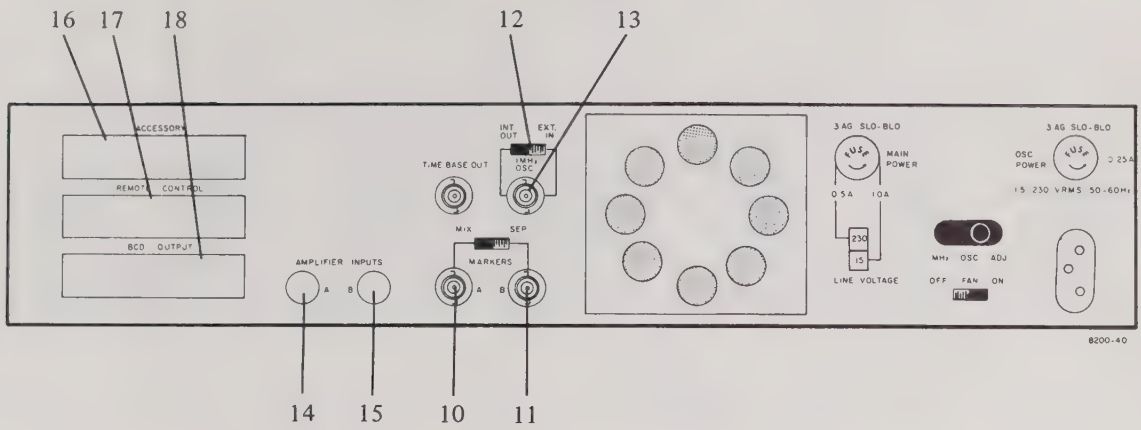


1. Connector for ac power input cord.
2. OSC POWER fuse for 1 MHz oscillator.
3. MAIN POWER fuse for instrument.
4. LINE VOLTAGE switch:
   a) Selects 115 V ac input when set to 115. Input is 115 V ±10%, 50 to 400 Hz.
   b) Selects 230 V ac input when set to 230. Input is 230 V ±10%, 50 to 400 Hz.
5. FAN switch:
   a) Connects primary power to fan when set to ON.
   b) Disconnects fan from primary power when set to OFF.

   CAUTION

   The fan operates on 50 to 60 Hz only. The FAN switch must be set to OFF when frequency of ac power is other than 50 to 60 Hz.
6. 1 MHz OSC ADJ control is frequency adjustment for 1 MHz oscillator.
7. Blower Air Filter Housing.
8. TIME BASE OUT connector monitors output from time base.
9. MARKERS switch:
   a) Selects 10 μsec marker pulses associated with channel A and channel B triggering pulses when switched to MIX. Mixed pulses are visible at MARKERS connectors A and B.
   b) Selects 10 μsec marker pulses associated with channel A and channel B triggering pulses when switched to SEP. Channel A markers are visible at MARKERS A connector; Channel B markers are visible at MARKERS B connector.

Figure 3-2. Rear Panel Description



10. MARKERS A connector is output for mixed marker pulses or channel A marker pulses only.

11. MARKERS B connector is output for mixed marker pulses or channel B marker pulses only.

12. 1 MHz OSC switch:

    a) Permits use of external oscillator in place of internal 1 MHz oscillator when switched to EXT.IN.

    b) Connects internal 1 MHz oscillator into circuit when switched to INT.OUT.

13. 1 MHz OSC connector:

    a) Permits connection of external oscillator to instrument when 1 MHz OSC switch is set to EXT.IN.

    b) Monitors output of internal 1 MHz oscillator when 1 MHz OSC switch is set to INT.OUT.

14. Location for optional input A connector (parallel with INPUT A connector on front panel of instrument).

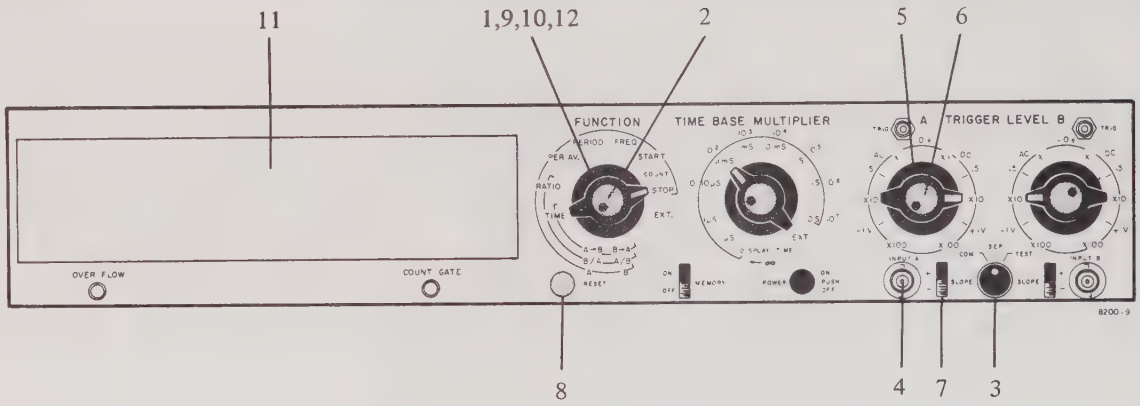
15. Location for optional input B connector (parallel with INPUT B connector on front panel of instrument).

16. ACCESSORY plate can be removed to provide location for installation of a connector.

17. REMOTE CONTROL plate can be removed to provide location for connection of a remote control programmer.

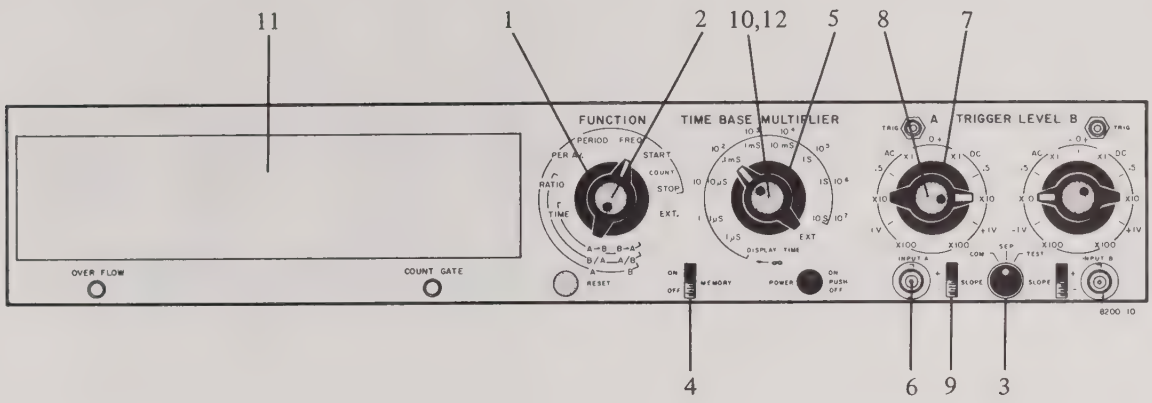
18. BCD OUTPUT plate can be removed to provide location for BCD output connector.

Figure 3-2. Rear Panel Description (Continued)



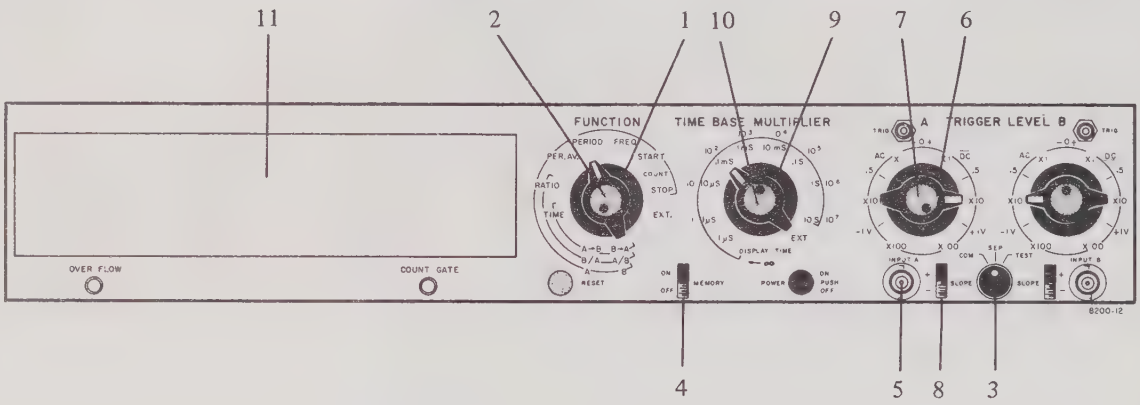
1. Set FUNCTION switch to STOP.
2. Set A-B Reverse switch to A.
3. Set COM-SEP switch to SEP.
4. Connect input to signal to INPUT A connector.
5. Set ATTENUATOR A switch to desired ac or dc mode and attenuation setting.
6. Set TRIGGER LEVEL A control to desired level.
7. Set INPUT A SLOPE switch to the desired polarity.
8. Depress RESET pushbutton.
9. Set FUNCTION switch to START. This starts counting action.
10. To stop counting action set FUNCTION switch to STOP.
11. Observe readout. Total number of counts is displayed on digital display.
12. To add more counts to reading, set FUNCTION switch back to START and then to STOP. The reading will be the sum of the counts.

Figure 3-3. Operating Instructions, Count Measurement



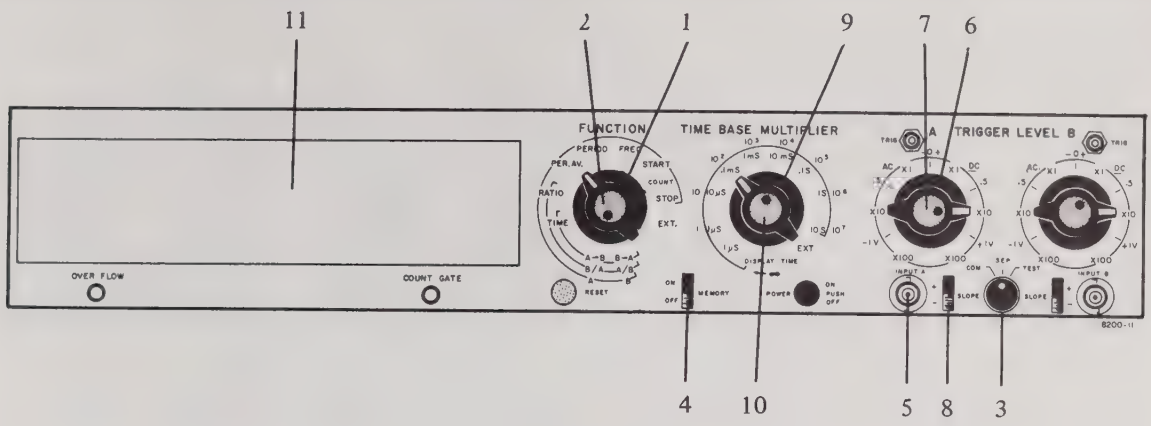
1. Set FUNCTION switch to FREQ.
2. Set A→B Reverse switch to A.
3. Set COM-SEP switch to SEP.
4. Set MEMORY switch to ON.
5. Set DISPLAY TIME control to minimum display time.
6. Connect the unknown signal to INPUT A connector.
7. Set ATTENUATOR A switch to ac or dc mode and attenuation setting.
8. Set TRIGGER LEVEL A control to desired level.
9. Set INPUT A SLOPE switch to desired polarity.
10. Set TIME BASE switch to 0.1 S.
11. If the frequency is between 10 Hz and 12.5 MHz, a reading should appear.
12. If the frequency is less than 10 Hz use 1 S or 10 S time base.

Figure 3-4. Operating Instructions, Frequency Measurement



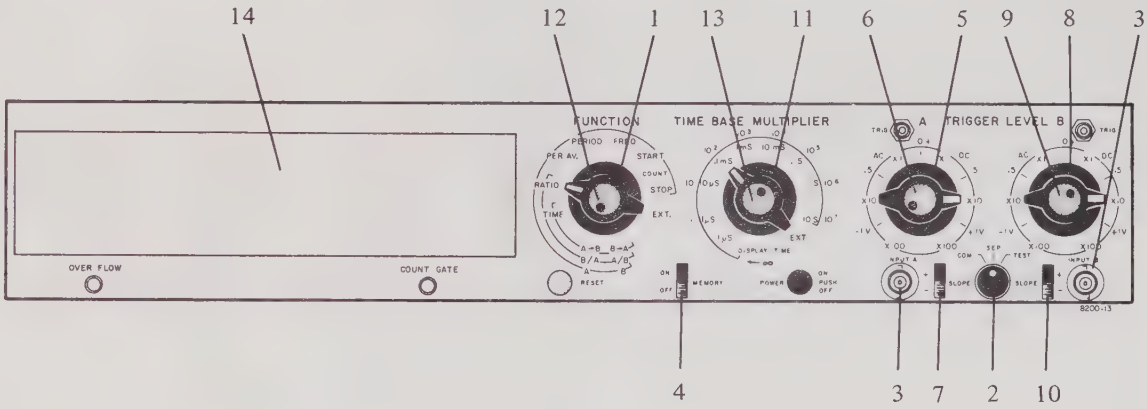
1. Set FUNCTION switch to PERIOD.
2. Set A-B Reverse switch to A.
3. Set COM-SEP switch to SEP.
4. Set MEMORY switch to ON.
5. Connect unknown signal to INPUT A connector.
6. Set ATTENUATOR A switch to ac or dc mode and desired attenuation setting.
7. Set TRIGGER LEVEL A control to desired level.
8. Set INPUT A SLOPE switch to desired polarity.
9. Set TIME BASE/MULTIPLIER switch to desired time base setting.
10. Set DISPLAY TIME control to minimum display time.
11. Observe readout. Period of measured signal is displayed at end of each time base interval.

Figure 3-5. Operating Instructions, Period Measurement



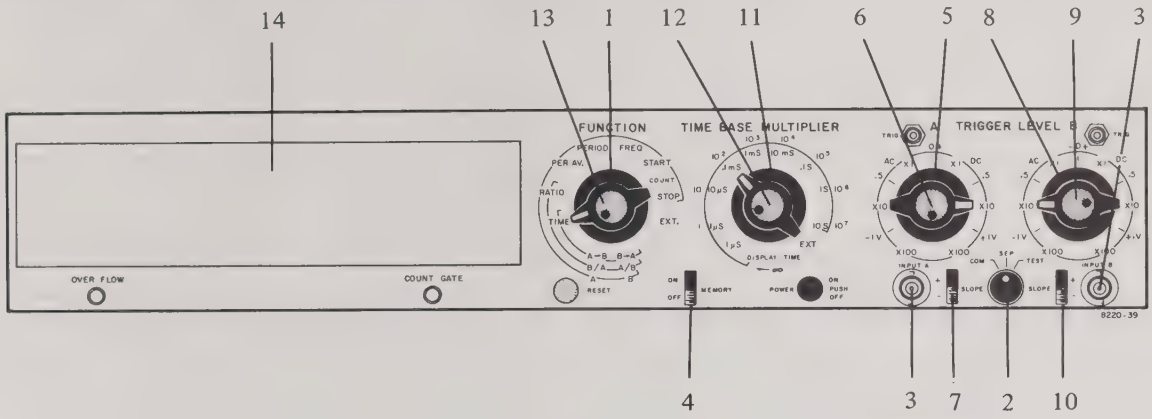
1. Set FUNCTION switch to PER.AV.
2. Set A-B Reverse switch to A.
3. Set COM-SEP switch to SEP.
4. Set MEMORY switch to ON.
5. Connect unknown signal to INPUT A connector.
6. Set ATTENUATOR A switch to ac or dc mode and desired attenuation setting.
7. Set TRIGGER LEVEL A control to desired level.
8. Set INPUT A SLOPE switch to desired polarity.
9. Set TIME BASE/MULTIPLIER switch to desired multiplier setting.
10. Set DISPLAY TIME control to minimum display time.
11. At end of interval (calculated as period of unknown x multiplier setting) the test result is displayed. Observe readout.

Figure 3-6. Operating Instructions, Period Average Measurement



1. Set FUNCTION switch to RATIO.
2. Set COM-SEP switch to SEP.
3. Connect unknown signal to INPUT A connector and the other to INPUT B. See table 1-1 for input frequency range for each input.
4. Set MEMORY switch to ON.
5. Set ATTENUATOR A switch to ac or dc mode and attenuation setting.
6. Set TRIGGER LEVEL A control to desired level.
7. Set INPUT A SLOPE switch to desired polarity.
8. Set ATTENUATOR B switch to ac or dc mode and attenuation setting.
9. Set TRIGGER LEVEL B control to desired level.
10. Set INPUT B SLOPE switch to desired polarity.
11. Set TIME BASE/MULTIPLIER switch to multiplier (derived from one of the two unknown signals).
12. Set A-B Reverse switch to either A→B or B→A as required.
13. Set DISPLAY TIME control to minimum display time.
14. Observe readout. Ratio is displayed on digital readout.

Figure 3-7. Operating Instructions, Frequency Ratio Measurement



1. Set FUNCTION switch to TIME.
2. Set the COM-SEP switch as follows:
   a) When a time interval between two points on the same waveform is measured, set COM-SEP switch to COM.
   b) When a time interval between two points on two waveforms or between two pulses of separate sources is measured, set COM-SEP switch to SEP.

   NOTE

   With the SLOPE switch set to +, rotating the TRIGGER LEVEL control counter clockwise generates a pulse; with the SLOPE switch set to -, rotating the TRIGGER LEVEL control clockwise will generate a pulse.
3. Connect the input signal to the input connectors as follows:
   a) Connect input signals to INPUT A connector and INPUT B connector when there are two input signals.
   b) Connect input signal to INPUT A connector when there is one input signal.
4. Set MEMORY switch to ON.
5. Set ATTENUATOR A switch to ac or dc mode and attenuation setting.
6. Set TRIGGER LEVEL A control to desired level.
7. Set INPUT A SLOPE switch to desired polarity.
8. Set ATTENUATOR B switch to ac or dc mode and attenuation setting.
9. Set TRIGGER LEVEL B control to desired level.
10. Set INPUT B SLOPE switch to desired polarity.
11. Set TIME BASE/MULTIPLIER switch to desired time base setting.
12. Set DISPLAY TIME control to minimum display time.
13. Set A-B Reverse switch either to A→B or to B→A.
14. The measurement is displayed on the readout.

Figure 3-8. Operating Instructions, Time Interval Measurement

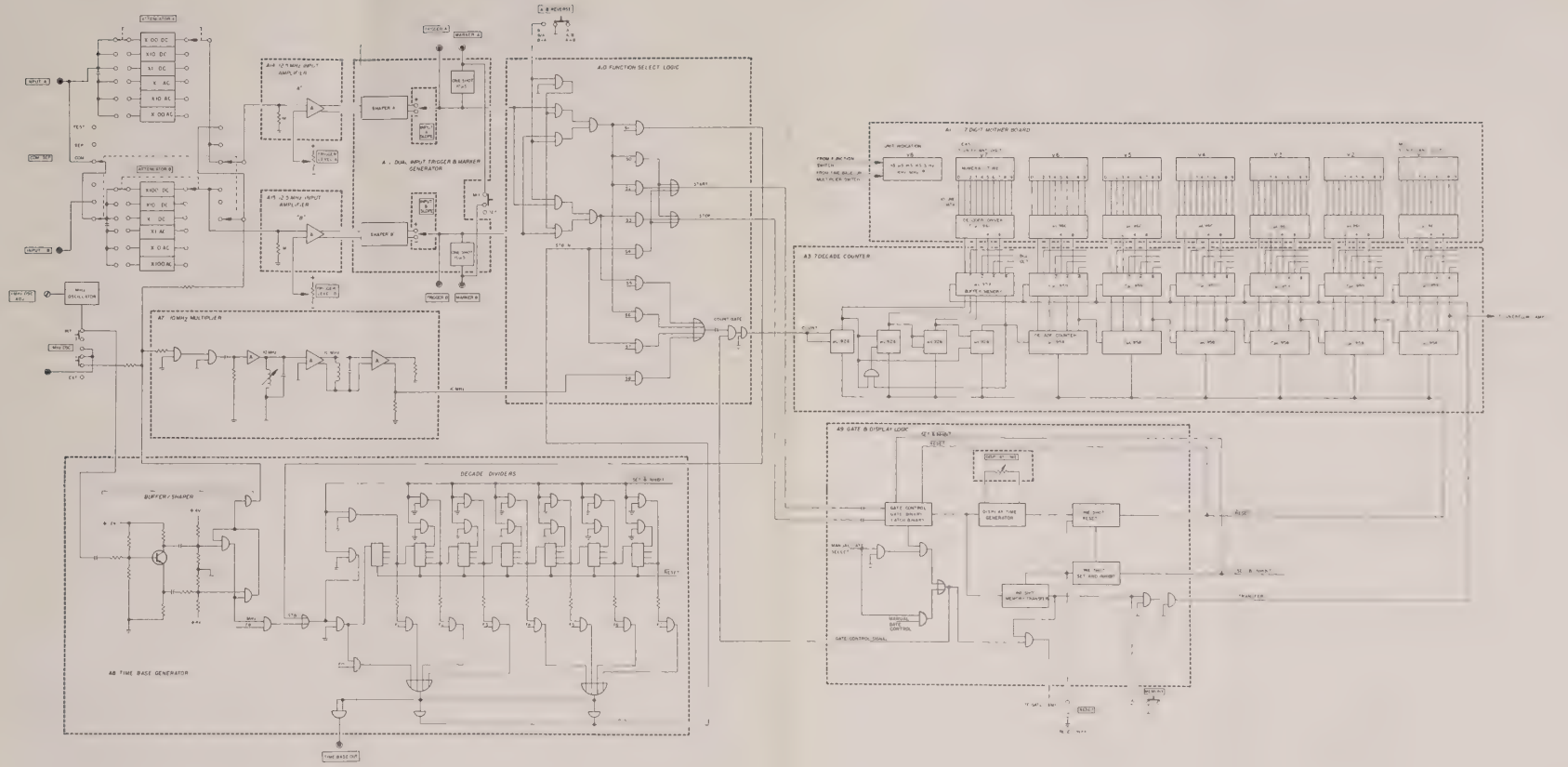


Figure 4-1. Detailed Block Diagram, Model 8200

Section IV
Theory of Operation

4-1. SCOPE OF SECTION

4-2. This section contains a discussion of the design and operating principles of the Fairchild Model 8200 Universal Counter Timer.

4-3. GENERAL DESCRIPTION

4-4. The Model 8200 is an integrated circuit, multifunction counter that measures the frequency and period of a signal; the time interval between two points on a signal, or on two related or unrelated signals; the ratio of two frequencies; or the total number of electronic pulses. Measurements are classified into two types of measuring functions, frequency and period; others are modifications of these two functions. The measuring technique compares the frequency or period of an unknown signal to a time base derived from a 1 MHz oscillator reference.

4-5. Figure 4-1 is a detailed block diagram of the Model 8200. The system consists of front panel controls, two identical input amplifier shapers, function select logic, gate control logic, time base, 1 MHz oscillator reference, decade counters, readout unit, and power supply (not shown in Figure 4-1). The FUNCTION switch on the front panel connects the appropriate circuit for the particular measuring function through function select logic. The TIME BASE switch selects a time base reference signal. The combined positions of the two switches determine the proper decimal point placement and unit indication in the readout. When an unknown signal is connected to the instrument, the input amplifier shaper converts the signal into a rectangular waveform. In frequency mode, the rectangular waveform is converted into counting pulses that are directed to the decade counters when the count gate is opened by the selected time base. In period mode, the rectangular waveform opens the count gate for one period of the unknown signal. During this period, the decade counters count the number of pulses from the time base. In either mode, the serial data is converted into BCD form by the decade counters. Then the BCD data is decoded into decimal outputs by the decimal decoders. The decimal decoders drive seven readout tubes that indicate measurement in seven digits with unit indication and decimal point placement. Display time of the measurement, independent of gate time, is manually adjustable from 0.1 to 5.0 seconds. The readout unit continuously displays the most recent reading at the end of each gate time.

4-6. LOGIC DEVICES

4-7. Fairchild Semiconductor Micrologic integrated circuit devices are used in Model 8200 circuitry. These devices are manufactured using the Fairchild Planar Epitaxial process by which all the necessary transistors and resistors are diffused into a single silicon wafer. The devices used in the Model 8200 are: μL900 inverting driver, μL904 half-adder, MWμL910 dual 2-input gate, MWμL911 4-input gate, μL914 dual 2-input gate, μL915 dual 3-input gate, μL926 JK flip-flop, CμL958 decade counter, CμL959 buffer/memory, CμL960 decoder/driver, DTμL937 hex inverter, and DTμL961 dual 4-input gate. A brief description of the RTL circuit, logic symbols used in instrument schematics, and logic devices follows.

4-8. RTL Circuit

4-9. The RTL gate circuit is shown in figure 4-2. It consists of an NPN transistor, a base resistor (R_B), and a collector load resistor (R_C). There is an input pin to R_B, and output pin at the collector, a power pin for V_{cc} (+3.6 V nominal), and a ground pin at the common

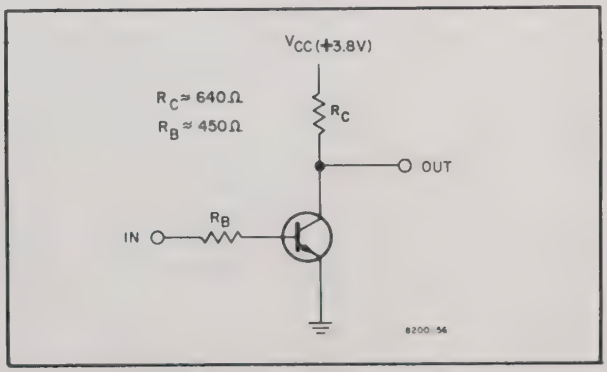


Figure 4-2. Basic RTL Gate

emitter point. Nominal values for R_B and R_C are 450 Ω and 650 Ω respectively. In operation, the circuit acts as a switch, with the output changing from a high (OFF) voltage level to a low (ON) voltage level. In the OFF condition, the output level is approximately the V_{cc} level of +3.6 V; in the ON condition, the output level is V_{SAT} (0.2 V to 0.3 V). An input level of 0 V to 0.74 V holds the output high; an input of 0.85 V to 1.5 V holds the output low.

4-10. **Logic Symbols**

4-11. The symbols used on Fairchild Semiconductor data sheets are standardized by MIL-STD-806B, dated February 26, 1962. Symbols used for a gate depend on whether the element is activated by a relatively high or relatively low signal. See figure 4-3. Each terminal of a device can have one of two states: zero or one. Zero is the reference or inactive state, and one is the significant or active state. The small circle at the point where a signal line joins the symbol indicates that the line's active state is the relatively low signal. The absence of such a circle indicates that the line's active state is the relatively high signal state. For positive logic, the symbol has no circles at the input and a circle at the output. Thus, inputs are normally low when inactive, and high when activated. The output is normally high, and goes low when the gate is activated by a high signal at the input. Thus, the element is performing the OR function, as indicated by the shape of the symbol, because a change of state in any one of the inputs causes a change of state in the output. For negative logic, the symbol has circles on its inputs and none on the output. All inputs must be low or in their active state before the output changes. Thus, this symbol shows the AND function.

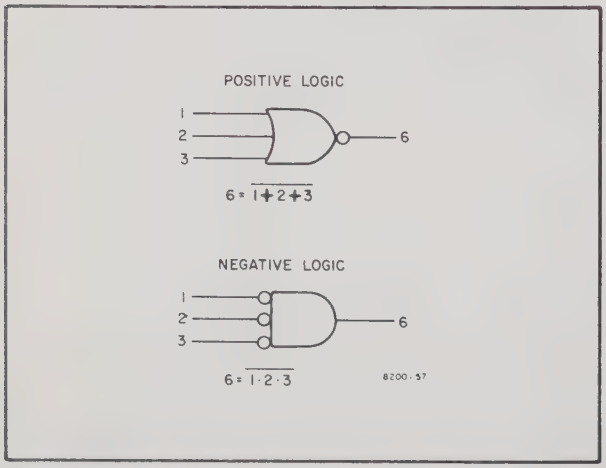


Figure 4-3. Logic Symbols

4-12. **Description of Elements**

4-13. The following is a brief description of the integrated circuit elements used in the Model 8200.

4-14. The μL900 is an inverting driver capable of supplying a 16 mA of current at 0.9 V input. A schematic of the μL900 and its logic symbols are shown in figure 4-4a.

4-15. The μL904 is a half-adder consisting of a multipurpose combination of three basic RTL circuits. See figure 4-4b. Output 7 is a noninverting function of the four inputs; output 6 may be considered as either a NAND or a NOR gate.

4-16. The MWμL910 is a dual 2-input gate. Each gate performs the NAND/NOR logic function. See figure 4-4c.

4-17. The MWμL911 is a 4-input gate. See figure 4-4d. Output 7 is a noninverting function of the four inputs; output 6 may be considered either a NAND or a NOR gate.

4-18. The μL914 is a dual 2-input gate. Each gate performs the NAND/NOR logic function. See figure 4-4e.

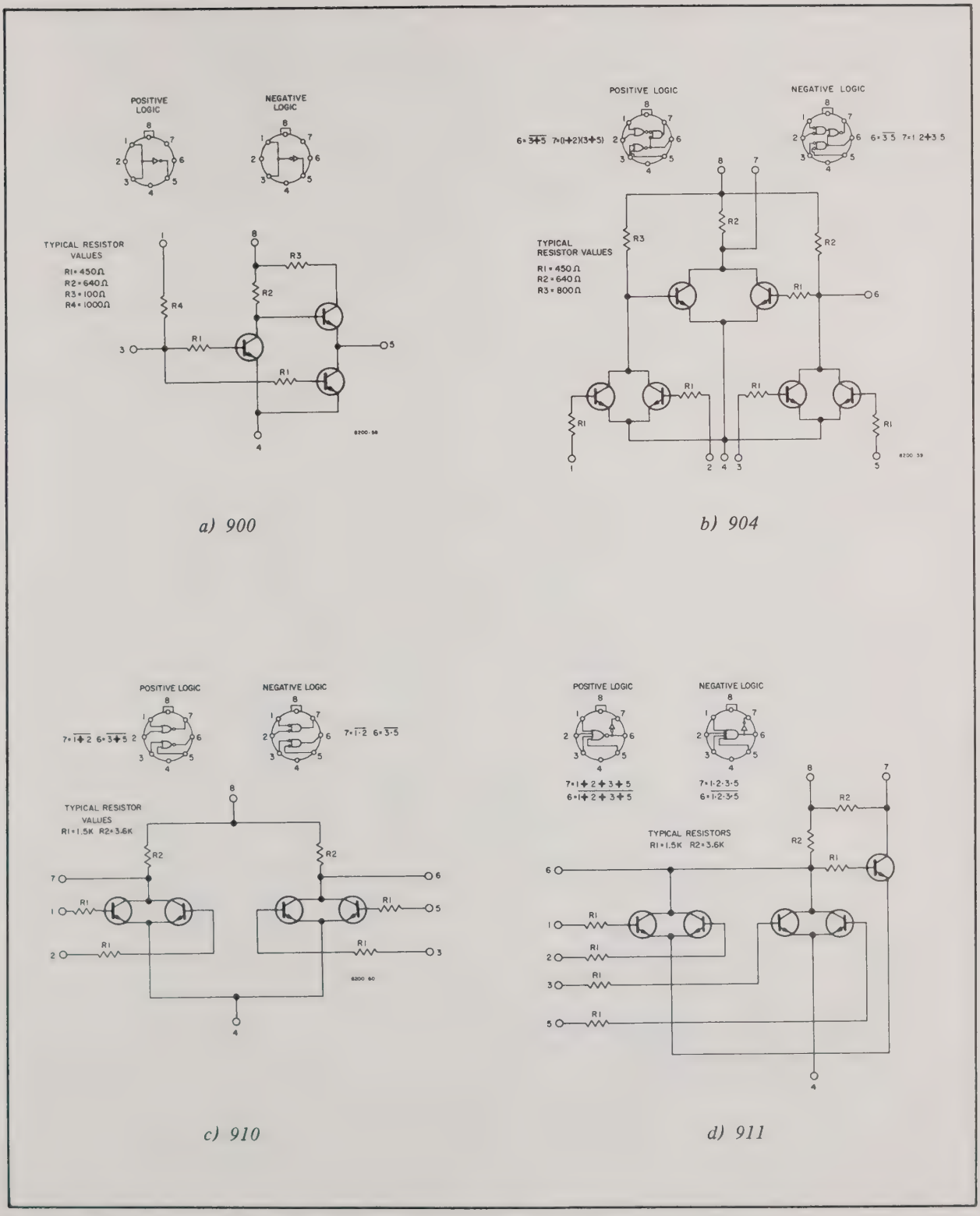
4-19. The μL915 is a dual 3-input gate. Each gate performs the NAND/NOR logic function. See figure 4-4f.

4-20. The μL926 is a JK flip-flop used as a control element, counter, etc. See figure 4-4g. The JK flip-flop differs from an RS flip-flop in that no ambiguous output state can result from simultaneous one inputs. In the JK flip-flop, a simultaneous one on both the set and clear causes the output state to toggle (reverse). The JK flip-flop has buffered outputs and a preclear connection.

4-21. The DTμL937 is a hex inverter. Inverters can be cross-connected to form flip-flops or the outputs can be paralleled to perform the wired OR function. See figure 4-4h.

4-22. The DTμL961 is a dual 4-input gate. Each gate performs the NAND/NOR logic function. See figure 4-4i.

4-23. The CμL958 is a monolithic silicon decade counter designed to operate at a maximum frequency of 2 MHz over a temperature range from 0°C to +75°C. Inputs consist of a count signal and a reset signal. Outputs are binary-coded decimals having a 1-2-4-8 relative



a) 900

b) 904

c) 910

d) 911

Figure 4-4. Integrated Circuit Elements

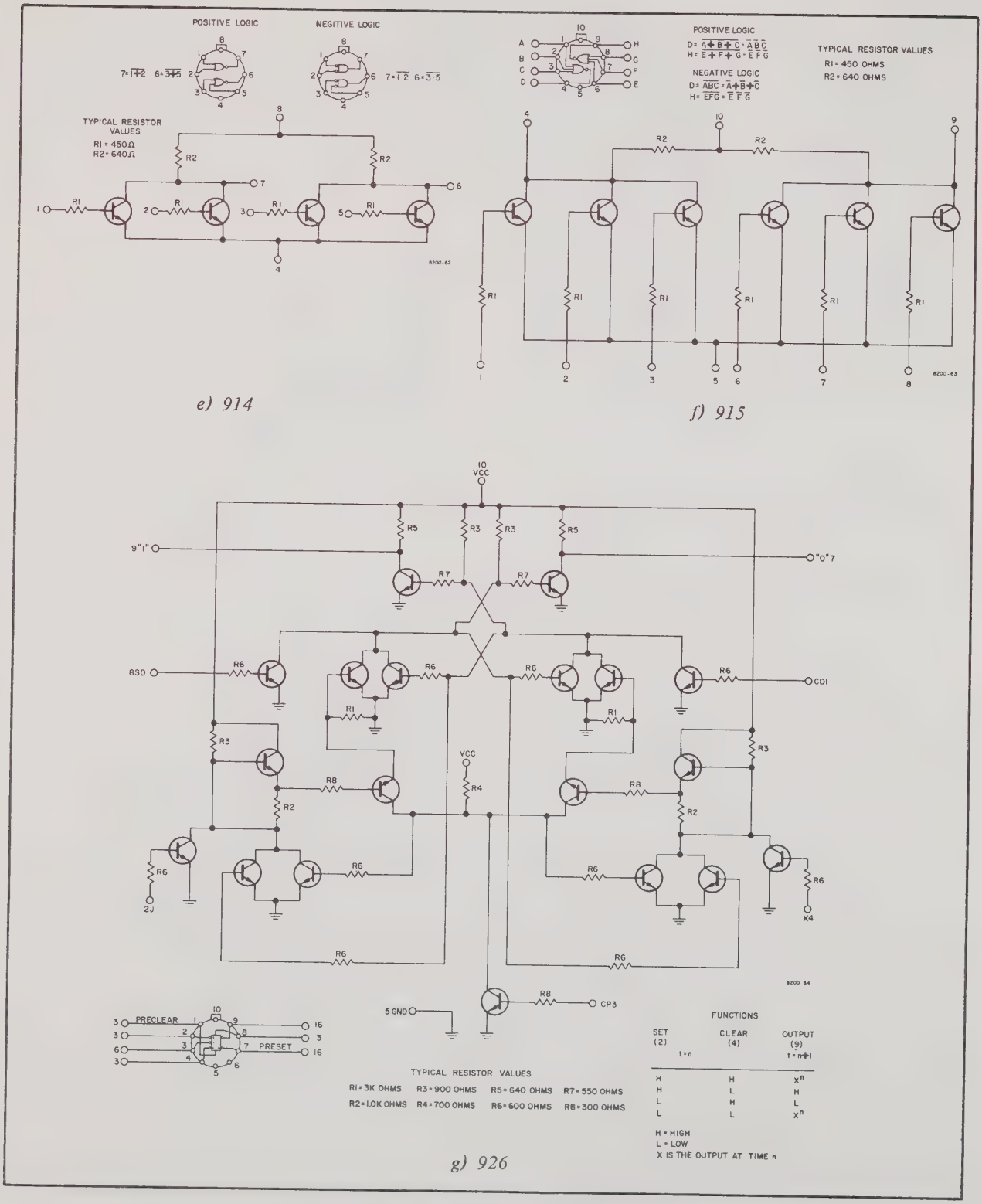


Figure 4-4. Integrated Circuit Elements (continued)

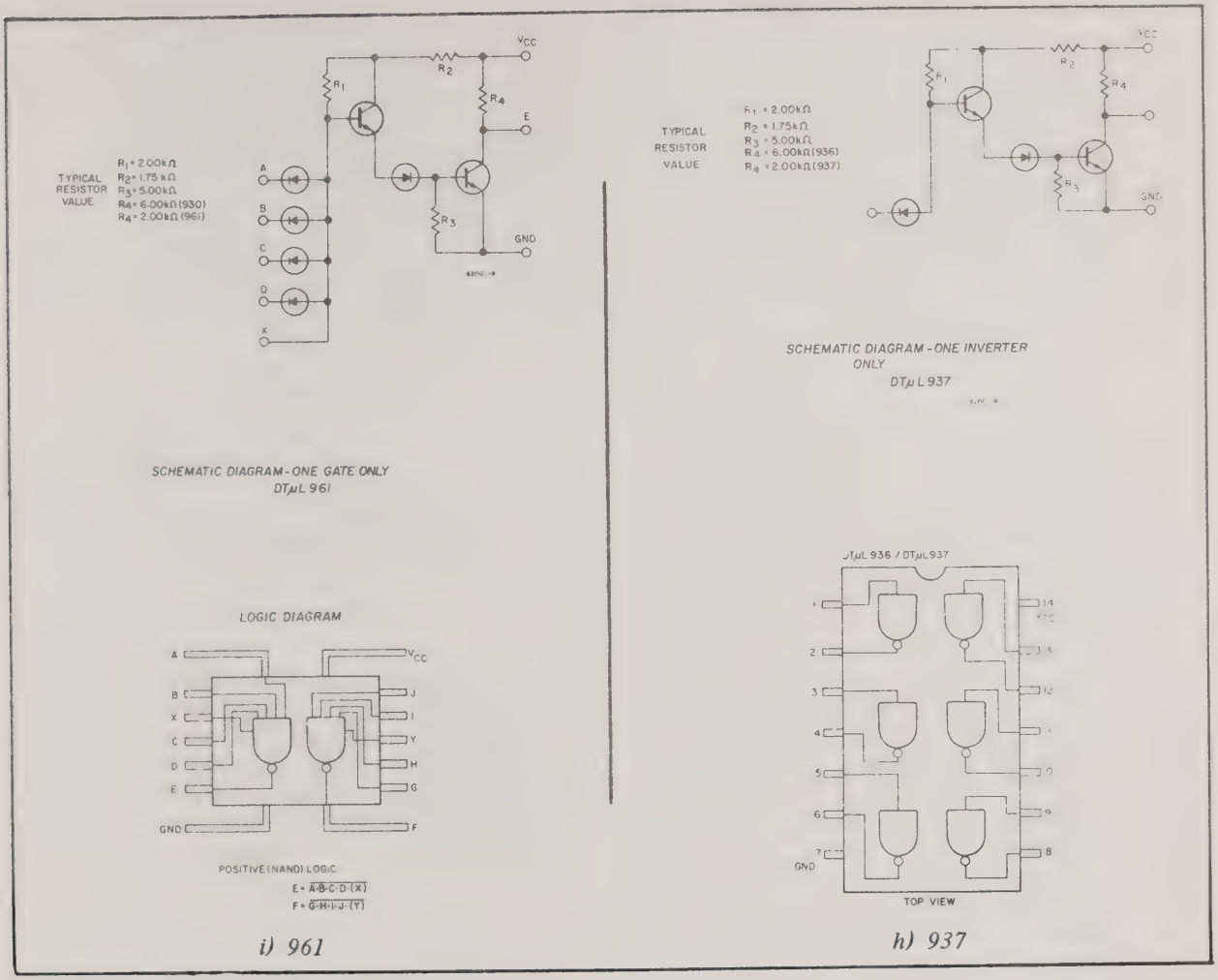


Figure 4-4. Integrated Circuit Elements (continued)

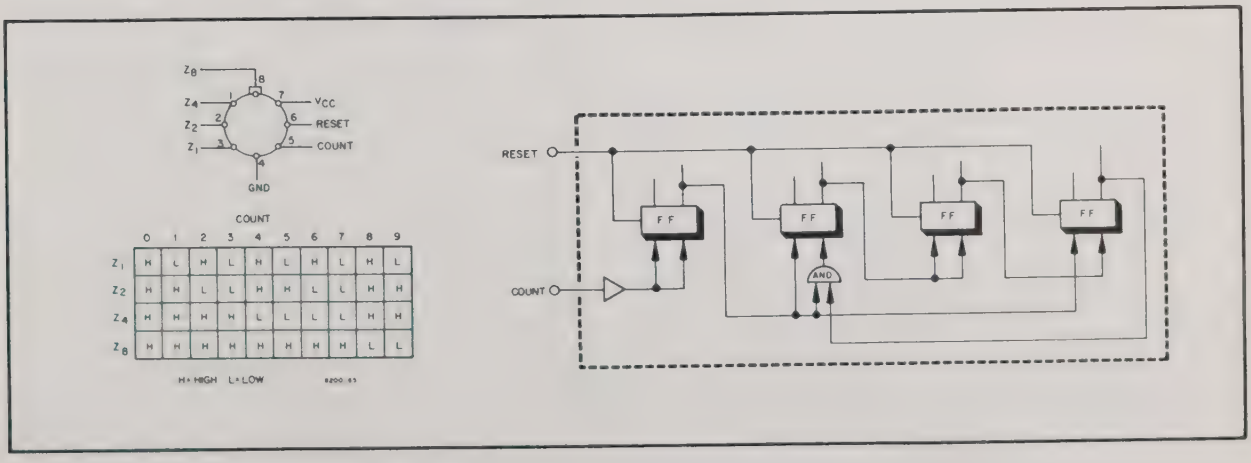


Figure 4-5. CμL958 Binary Counter Unit

weighing. Individual outputs may be pulled to ground after resetting to establish any of nine nonzero states in the normal decade sequence. The counter consists of four flip-flops and an input amplifier. See figure 4-5. The flip-flops are interconnected so that a modulo-16 count is permuted at the end of ten counts, returning to the first count rather than the eleventh. The circuit is reset to count 0 (all outputs high) with a high level on the reset input pin 6. To preset the decade to an arbitrary count, the unit must be reset to count 0, and the reset pin returned to a low level followed by a ground (<0.45 V) on the appropriate outputs.

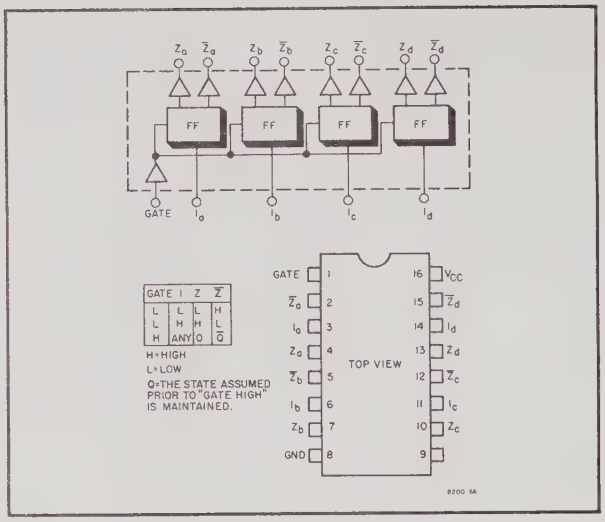


Figure 4-6. CμL959 Buffer/Memory Unit

4-24. The CμL959 buffer/memory unit consists of four gated latch circuits whose input characteristics match the 958 counter output characteristics. (See figure 4-6. This unit a) allows the state of the counter outputs to be sampled and held for an indefinite period, b) provides both true and complimentary signals, and c) provides a method of signal conversion where external circuitry is to be driven. Information present at four data inputs enters the latches throughout the interval of a load command applied at the gate input terminal. With gate high, information is stored until a subsequent load command permits a change. The duration of the gate signal is unimportant to the storage action. If the gate input is disconnected, the outputs follow whatever changes occur at the inputs.

4-25. The CμL960 is a decimal decoder circuit that accepts 1-2-4-8 binary-coded inputs and produces 10 mutually exclusive outputs that directly control the ionizing potential of the type NL-841 cold cathode decimal indicator tube. Figure 4-7 shows how low signals are accepted as logic "ones" and high signals as logic "zeroes".

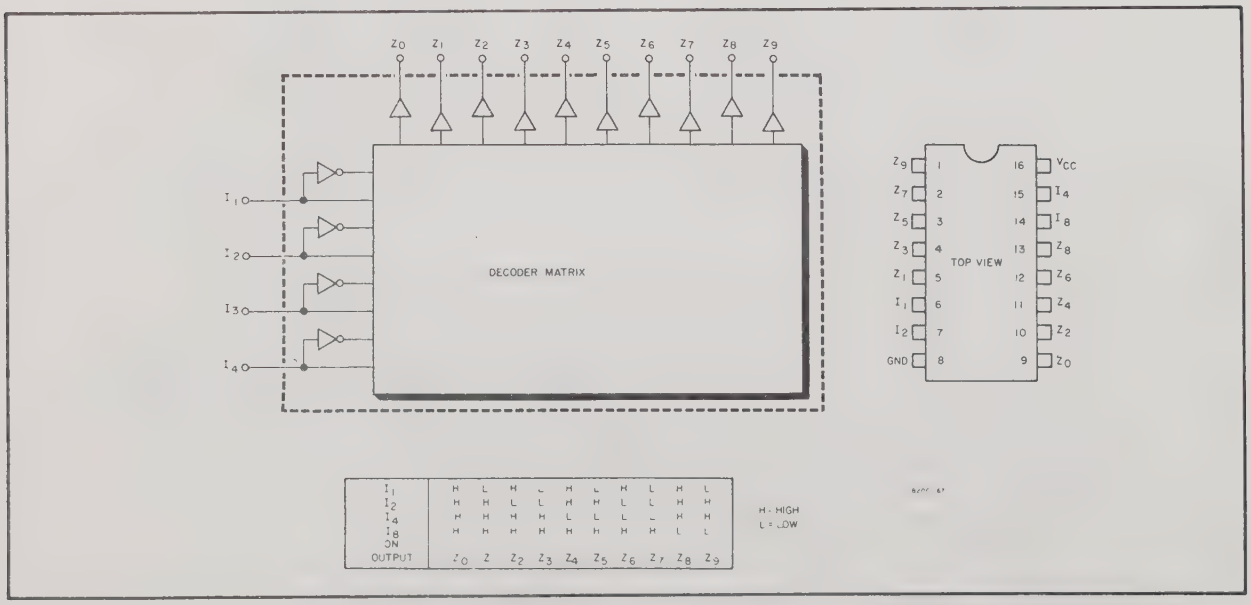


Figure 4-7. CμL960 Decimal Decoder Unit

4-26. READOUT TUBE

4-27. The readout tubes in the instrument are type NL-841 and NL-828, both manufactured by National Electronics, Inc. Each tube is a cold cathode diode with multiple cathodes. Each cathode is shaped like a display character (0 through 9, decimal point, unit of measurement) with a separate base pin electrical connection. Negative voltage, with respect to anode, applied to the character base pin causes the shaped glow discharge.

4-28. FUNCTION SELECT LOGIC

4-29. A simplified circuit of the function select logic is included in figure 4-1, and a detailed schematic is shown in figure 5-25. Function select lines, S0 through S8 are selected directly by the FUNCTION switch on the front panel. Table 4-1 lists the lines selected for each mode of operation. The desired mode of operation is obtained by grounding corresponding function select lines

4-30. The count gate in the function select logic gates the count pulses to the decade counters. Output pulses from the time base, or from the A or B shaped input signal, are differentiated by the capacitor into 50 nsec counting pulses. These 50 nsec pulses then are directed to the decade counters when the count gate is opened by the "Gate Control Signal."

Table 4-1. Function Select Lines

FUNCTION	SELECT LINES		
Time Interval	S2	S3	F8
Ratio	S4	S1	S5
Per.Av.	S4	S1	S8
Period	S0	F8	S7
Freq.	S4	S6	F8
Count Start	S4	S6	F8
Count Stop	S4	S6	F8

4-31. GATE AND DISPLAY LOGIC

4-32. Figure 4-8 is a schematic of the gate and display logic which consists of circuits for manual or automatic gating, timing sequence control, and display time.

4-33. When the instrument is in COUNT mode, the logic signal "Manual Gate Select" goes low and puts a low input to gate Q5. This gives the FUNCTION switch direct control over "Gate Control Signal" (the output of Q5). When the instrument is not in COUNT mode, the logic signals "Manual Gate Select" and "Manual Gate Control" remain high so that the "Binary Gate" Q3/Q4 controls "Gate Control Signal". Q3/Q4 is triggered by the logic signals "Start" and "Stop" from the time base generator.

4-34. The display time generator controls display time for the numeric readout. Q1 normally is on. When the decade counters complete counting, Q1 turns off. C1 begins to charge up through R1, R2 and R3. The rate of charging depends upon the value of the series resistors. Varying R2 (front panel DISPLAY TIME control) will vary the time to charge up C1 to the voltage which triggers the unijunction transistor Q2. Once Q2 triggers, point A goes low, and triggers two single-shot multivibrators labeled Reset, and Set & Inhibit, which starts another measuring cycle.

4-35. The single-shots, Reset, Set & Inhibit, and Transfer in the logic circuit control the timing sequence. The Reset signal resets the decade-counters, time base generator, and gate binary. Set & Inhibit inhibits the decade dividers in the time base. Transfer transfers data from decade counters CμL958 to storage/buffer CμL959. Figure 4-10 shows timing of the single-shots, the time base, Gate Control Signal, and display time in a typical frequency measurement.

4-36. INPUT AMPLIFIER SHAPER

4-37. There are two identical input amplifier shapers, designated A and B. The amplifier schematic is shown in figure 5-34.

4-38. Each amplifier is a differential amplifier with an input impedance of 1 MΩ in parallel with 50 pf, and an output impedance of 200 Ω. In figure 5-34, the dual FET Q5 provides temperature tracking so that the trigger level remains fixed over the entire temperature range. The dual FET also provides good common mode operation to make the trigger level independent of short and long term power supply variations. The potentiometer on the front panel adjusts the trigger level for the input signal. Differential gain of the amplifier is approximately five.

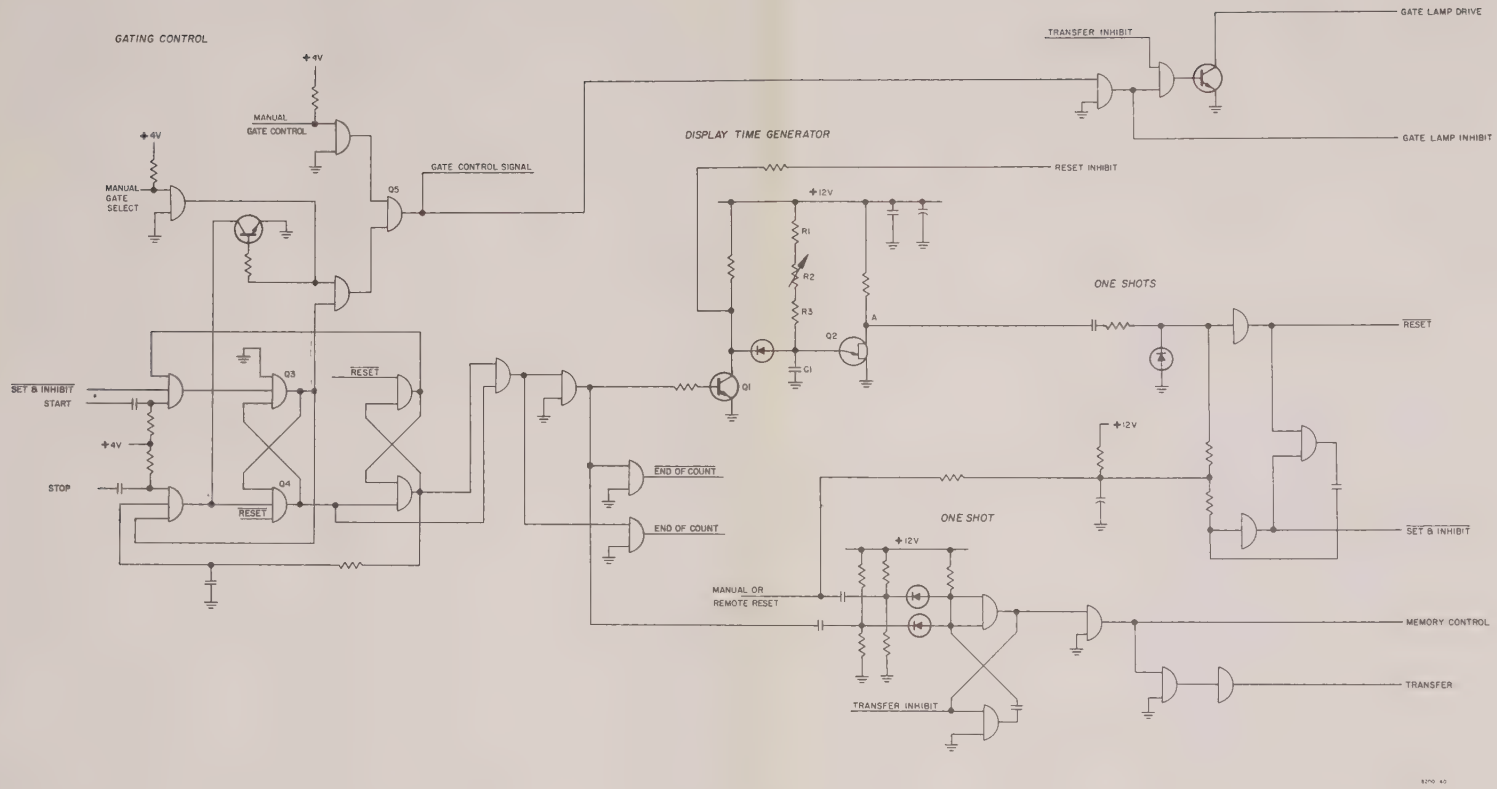


Figure 4-8. Schematic, Gate and Control Logic

4-39. The input shaper is a differential trigger circuit that converts the output of the amplifier into a rectangular waveform. In figure 5-32, the lower half of the schematic shows trigger circuit A. With Q15 and Q16 providing positive current feedback, Q13 and Q14 form a trigger circuit with approximately 0.5 V of hysteresis. The outputs are connected to differential amplifier Q20 and Q21 whose positive or negative output can be selected by the SLOPE switch. When the SLOPE switch is positive, Q18 and Q19 are turned on and Q17 off, permitting the positive output from Q20 to pass through Q23. When the SLOPE switch is negative, Q17 is turned on and Q18 and Q19 off, permitting the negative output from Q21 to pass through Q22.

4-40. TIME BASE

4-41. The time base is used as a reference signal for frequency, period, and time interval measurements. See figure 4-1. The time base circuit consists of a 10 MHz multiplier, seven decade dividers, and a reference 1 MHz oscillator. The 1 MHz signal is fed to the 10 MHz multiplier to generate 10 MHz. It also is fed to seven CμL958 elements, connected in cascade, to produce time base signals of 0.1 Hz to 100 kHz in decade steps. F0 through F7 are the select lines corresponding to 1 μsec through 10 seconds time base. The TIME BASE switch on the front panel selects a desired time base by grounding the corresponding select line.

4-42. For ratio and period average measurements, the seven decade dividers in the time base divide STB, a shaped input signal, by 1 to 10^7 in decade steps. In these modes, F8 is high to prevent the 1 MHz signal from passing into the decade dividers.

4-43. DECADE COUNTERS AND NUMERAL DISPLAY

4-44. A block diagram of the circuit is shown in figure 4-1. The seven decade counters are connected in cascade. The first counter, which consists of four JK flip-flops (μL926), is a high-speed binary capable of counting up to 12.5 MHz. The other six are Fairchild Micrologic CμL958 decade counters. BCD outputs of each decade counter are decoded into decimal outputs by a decimal decoder CμL960 whose output lines drive a numeric indicator. The signal transfer to the buffer storage unit CμL959 provides a simple means for sampling the CμL958. A low going Transfer signal permits the outputs to follow the information from the decade counter. If the signal transfer is returned to high logic level, the last state of the decade counter is stored in the buffer storage unit. When the MEMORY switch on the front panel is OFF, outputs of the CμL959 follow whatever changes occur at the inputs.

4-45. POWER SUPPLY

4-46. The power supply circuit is shown in figure 5-20. The unit supplies five regulated outputs: 20 mA, +12 V, -12 V, +4 V and +27 V. All are provided with short circuit protection. The voltage regulator circuits are similar, therefore only the +12 V supply is described in detail.

4-47. The +12 V supply consists of an unregulated source, output voltage detector Q4, series regulator chassis Q2 (mounted on chassis), and driver Q3. Q4 senses and compares the output voltage through R11 and R13 with a stable reference established by zener diode CR7. Any change in output is applied as a correction to the series regulator to bring the output back to the original level. The output is set to +12 V by adjusting potentiometer R12. Short circuit protection is provided by Q2 and R1. If the load current exceeds 320 mA on short circuit, voltage across R1 turns Q2 on, thereby limiting the output current to 320 mA.

4-48. COUNT MODE (TOTALIZING)

4-49. In this mode, the instrument displays the total number of signals received. The block diagram of the circuit is shown in figure 4-9. An unknown signal is amplified and shaped into a rectangular waveform by the input amplifier shaper. The count gate is opened by grounding the "Manual Gate Control" signal when switching the FUNCTION switch to START. Likewise, the count gate is closed by switching the FUNCTION switch to STOP. When the count gate is open, the pulses from the shaper are directed to the decade counters. Once the count gate is closed, the readout unit displays the total number of counts received.

4-50. FREQUENCY MODE

4-51. Frequency is the number of signals per unit of time. Therefore, the frequency measuring circuit requires a circuit to record the number of counts and a circuit to generate the time base. The block diagram is shown in figure 4-10. The decade counters receive pulses in the same manner as in the count mode, but the count gate is opened by the time base selected on the front panel. Through the gate control logic, the first low going edge of the time base following the "Set & Inhibit" signal opens the count gate and the second low going edge of the time base closes it.

4-52. By counting the number of pulses in a known time interval, the readout unit displays the frequency of the unknown signal. For example, setting the time base to 1 msec on the front panel causes the count gate to open for 1 msec. If the decade counters receive six counts during this time interval, the readout will read 6 kHz.

4-53. PERIOD MODE

4-54. The period of a signal is the reciprocal of its frequency. In this mode, the unknown signal controls the count gate while a known signal from the time base is directed to the decade counters. See figure 4-11. The unknown signal opens the count gate for one period during which the decade counters count the number of pulses from the time base. For example, if the time base is set at 1 μsec and the decade counters receive seven counts, the period of the unknown input must be seven times the 1 μsec time base. The readout will read 7 μsec.

4-55. PERIOD AVERAGE MODE

4-56. In a single period measurement an error exists due to input signal jitter and noise from the input amplifier. Error in one period can be reduced by taking period average measurements. In this mode, the instrument measures the number of periods selected on the front panel, and takes the average of the reading. The decimal point also is positioned automatically in the readout indicator. Error is averaged in this way also.

4-57. Refer to figure 4-12. An unknown input signal is applied to the decade dividers. The MULTIPLIER switch selects the number of periods from the outputs of the decade dividers. The readout unit automatically takes the average of the measurement and displays it on the readout tubes.

4-58. RATIO MODE

4-59. This mode measures the ratio of two unknown frequencies. Refer to figure 4-13. One unknown, the numerator, is directed to the decade counter through the count gate; the other unknown, as the denominator, is applied to the period dividers which control the opening of the count gate. In this way, one frequency is compared to the other. The average of the ratio can be obtained in the same way as in the period average measurement.

4-60. TIME INTERVAL

4-61. This mode measures the time interval between two points of a signal or between two points of two individual signals. See figure 4-14. The COM-SEP switch on SEP separates the two input channels A and B. The COM-SEP switch on COM connects input amplifier B to input A connector; only the signal to input A is measured. The output from channel A opens the count gate, and the output from channel B closes it. During this time interval, the decade counters count the pulses from the time base. For example, if the time base is set at 10 μsec and the counters receive 3 counts, the time interval between the two points is 30 μsec. The measurement is displayed on the readout tubes.

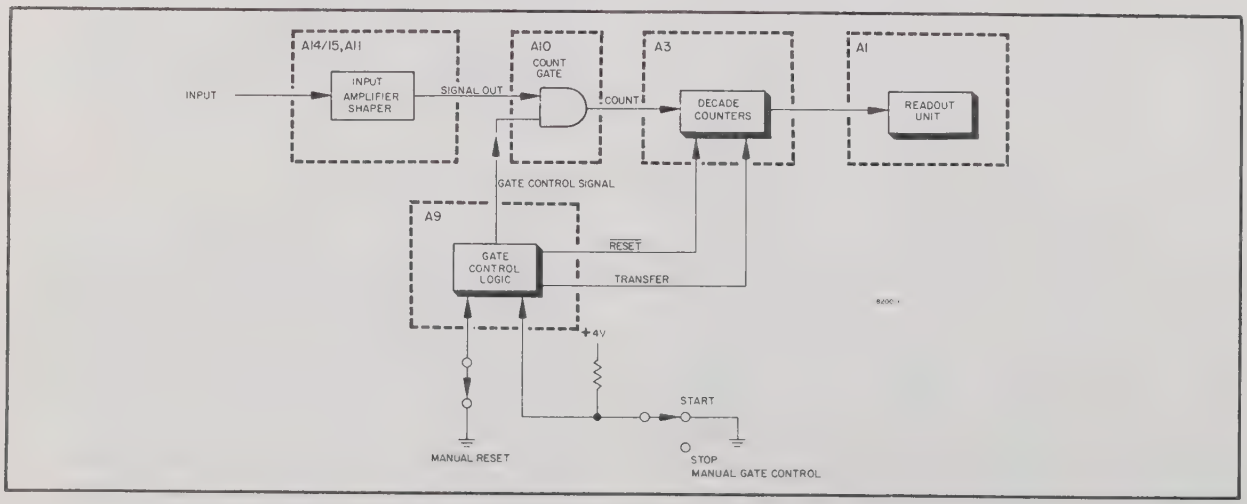


Figure 4-9. Block Diagram, Count Mode

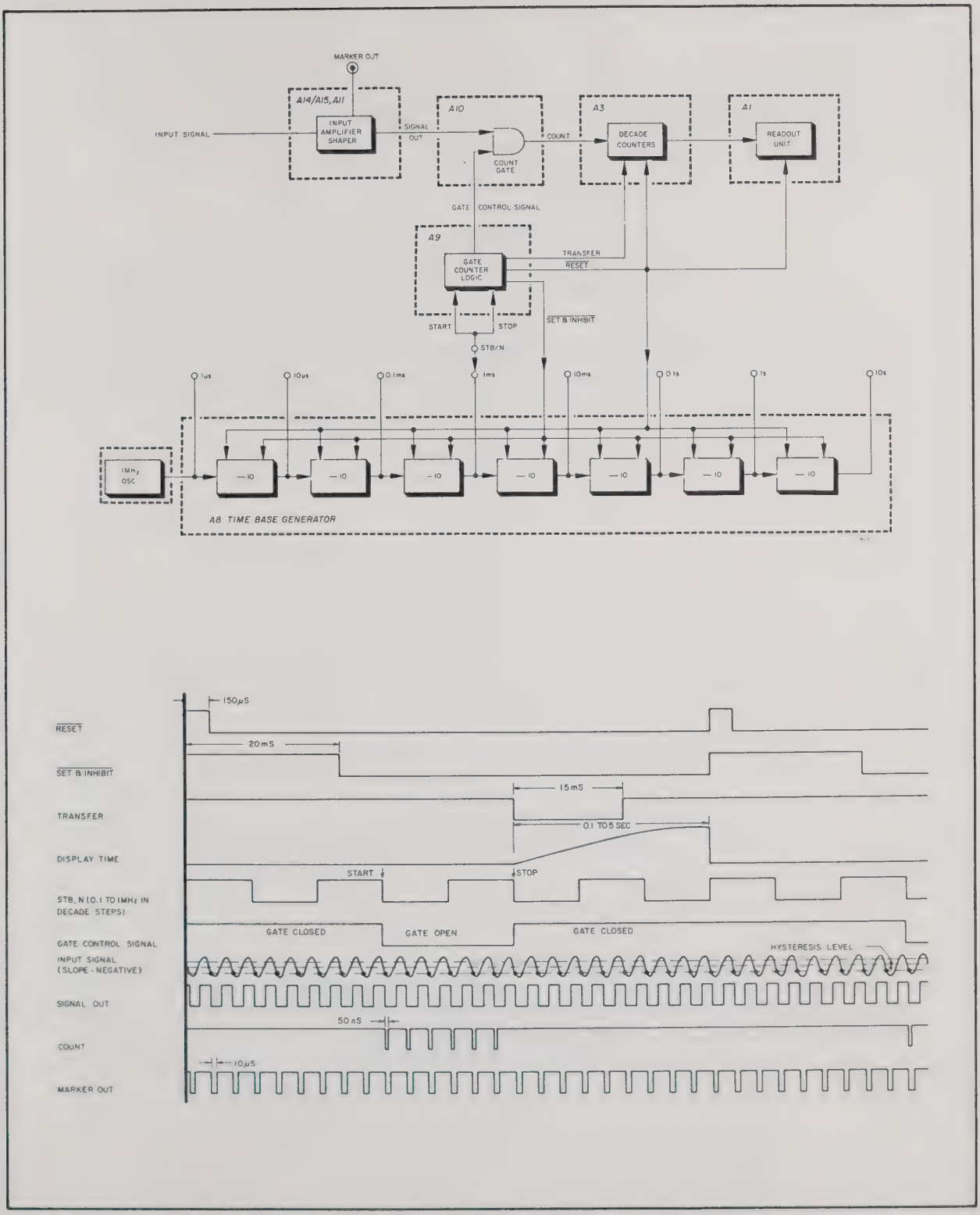


Figure 4-10. Block Diagram and Timing Waveforms, Frequency Mode

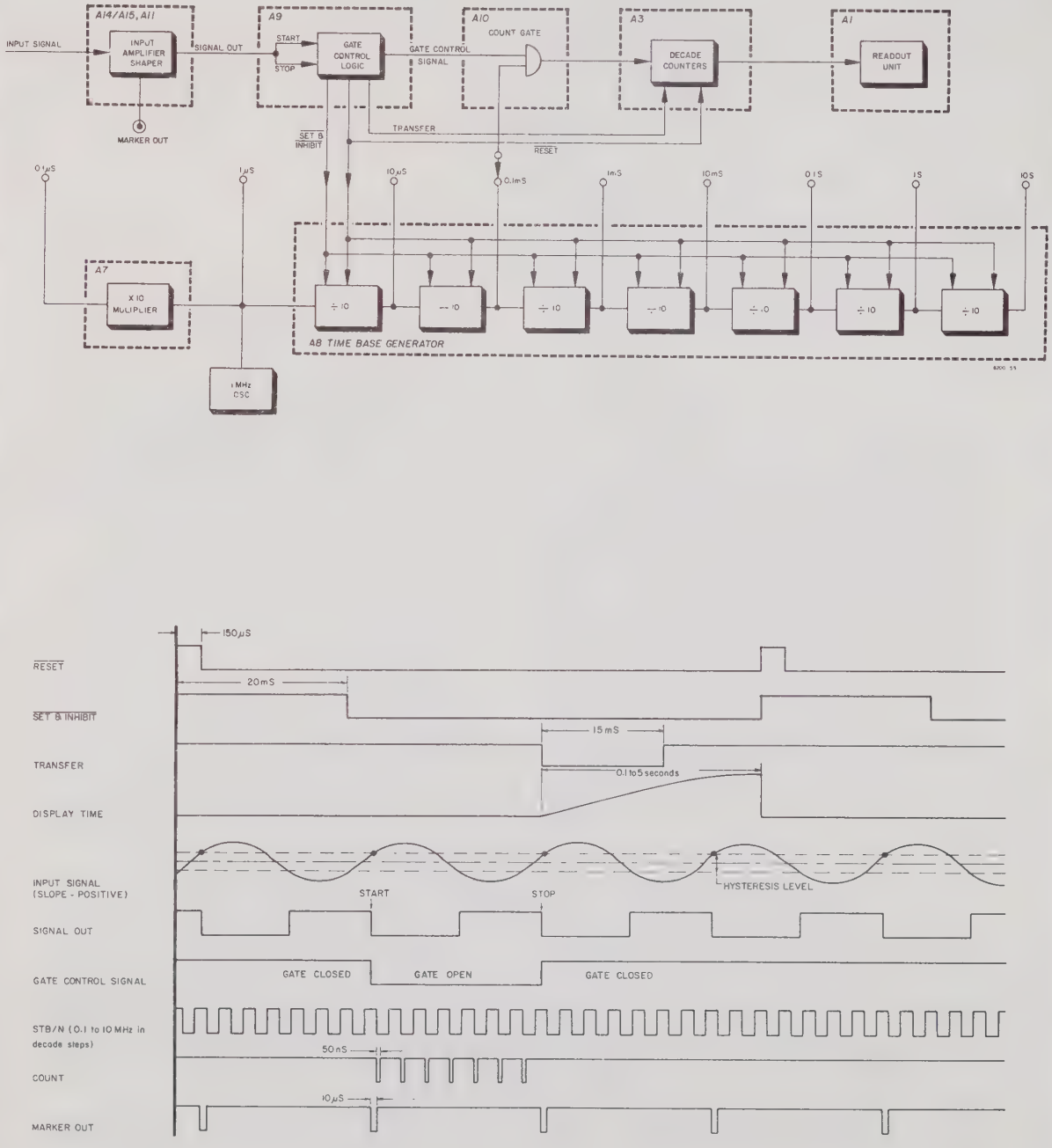


Figure 4-11. Block Diagram and Timing Waveforms, Period Mode

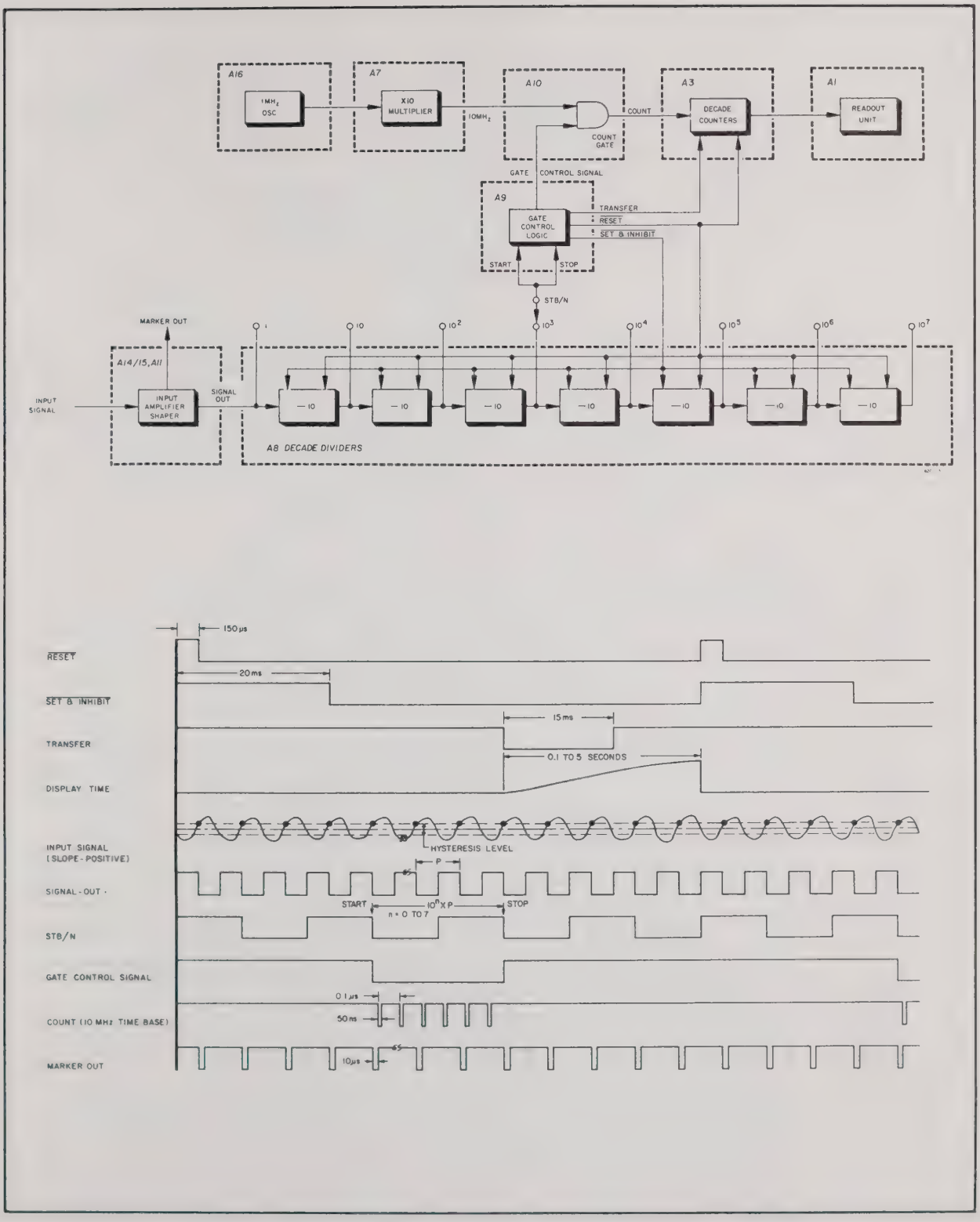


Figure 4-12. Block Diagram and Timing Waveforms, Period Average Mode

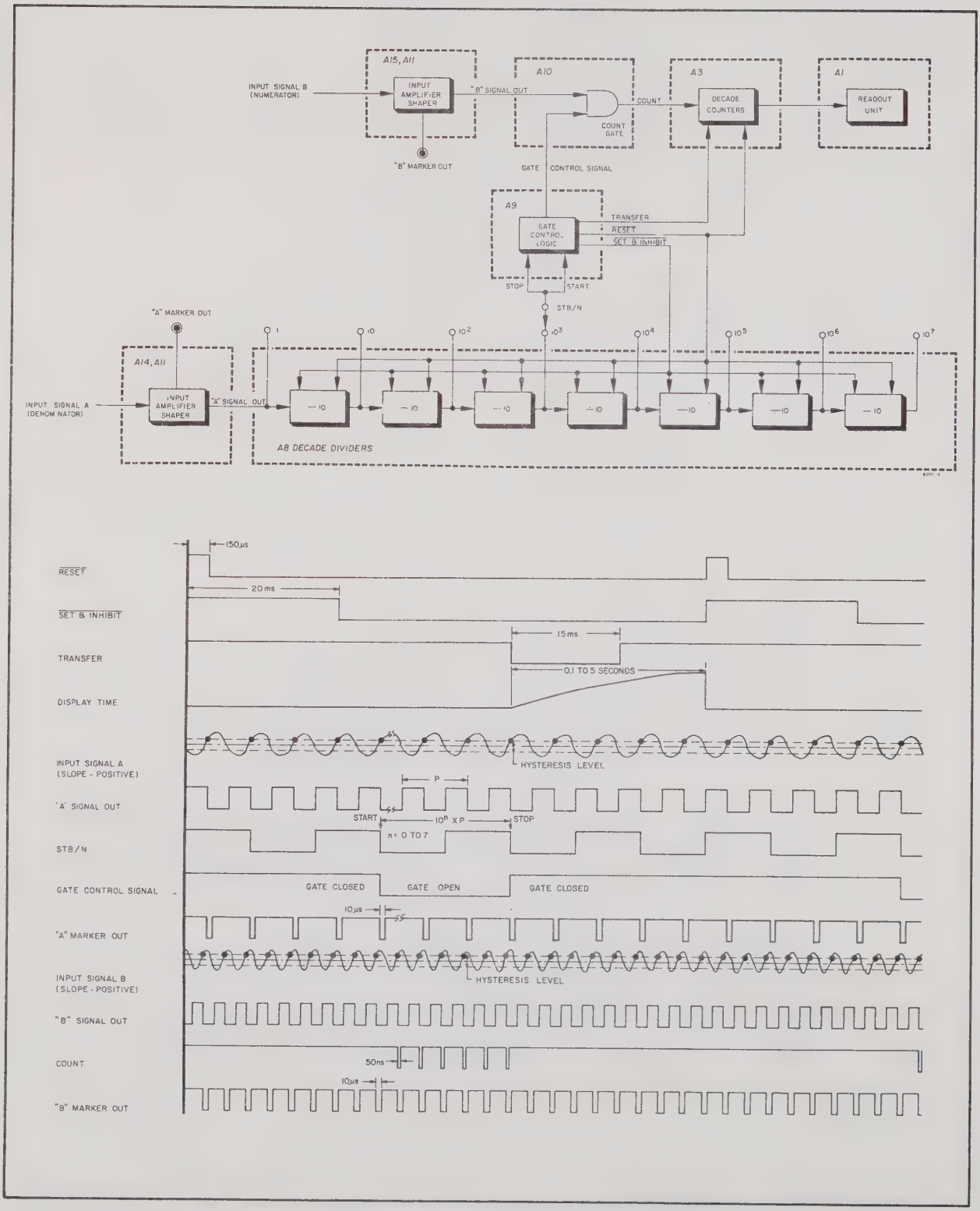


Figure 4-13. Block Diagram and Timing Waveforms, Ratio Mode

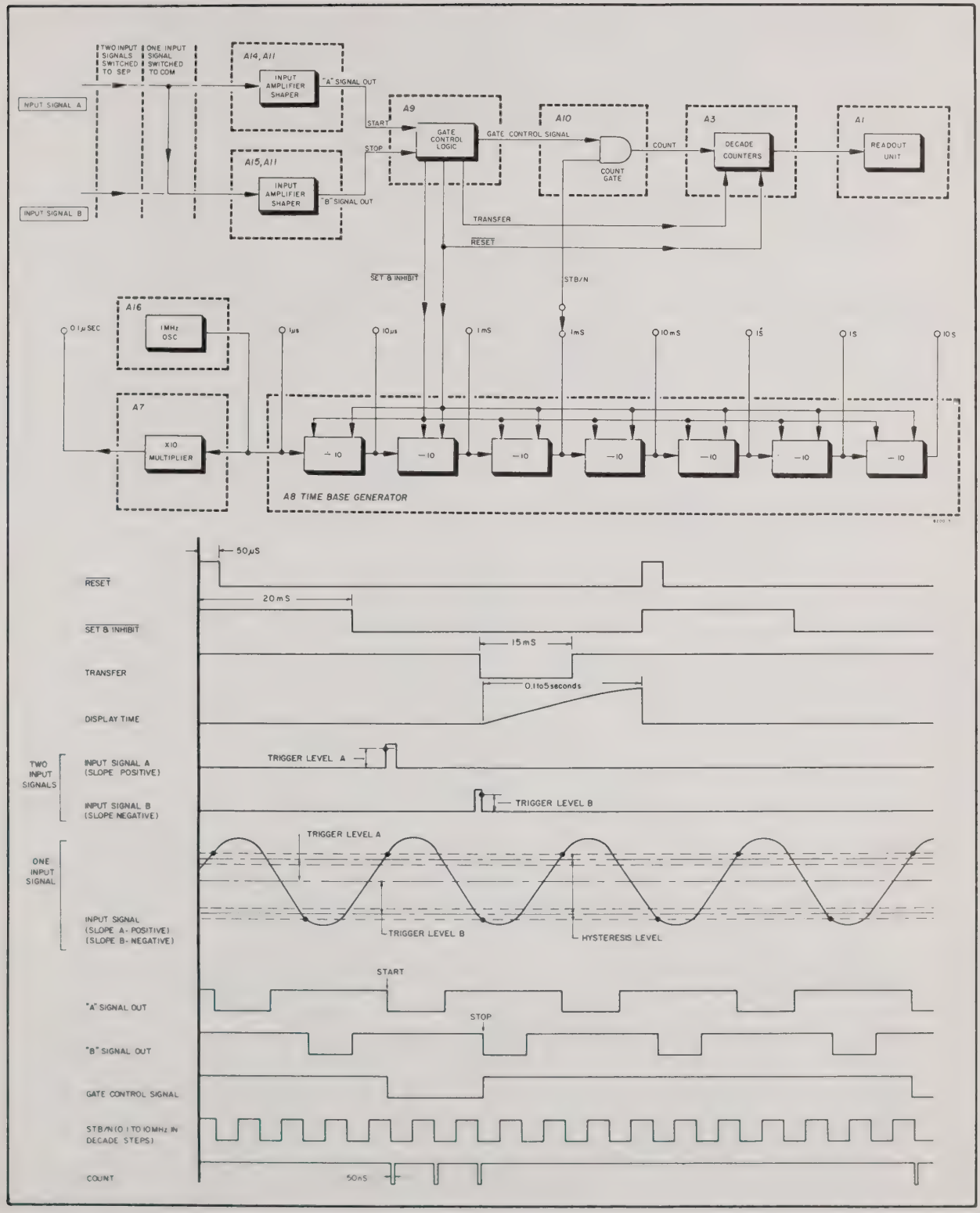


Figure 4-14. Block Diagram and Timing Waveforms, Time Interval Mode

Section V
Maintenance

5-1. SCOPE OF SECTION

5-2. This section contains information for calibration and maintenance of the Model 8200.

5-3. TEST EQUIPMENT REQUIRED

5-4. Table 5-1 lists test equipment required for performance check, troubleshooting and adjustment. If the recommended equipment is not available, equipment with equivalent specifications may be substituted.

5-5. PERFORMANCE CHECK

5-6. The performance check outlined in the following paragraphs is used to verify the specifications of the Model 8200. It can be used upon receipt of a new instrument, for routine preventive maintenance, and following repair.

NOTE

If the instrument fails to meet the standards of the performance check at any time, proceed to the appropriate adjustment procedure to correct the malfunction.

Table 5-1. Test Equipment Required

Equipment Type	Specifications		Recommended Instrument
Digital Voltmeter	Range:	0 to 300 V	Fairchild Model 7050 Digital Multimeter
	Accuracy:	±0.1%	
	Input Impedance:	10 MΩ	
Oscilloscope	Frequency Range:	0 to 25 MHz	Fairchild Model 766H
	Sensitivity:	50 mV minimum	
Frequency Standard	Frequency:	1 MHz	Hewlett-Packard Model 107AR Quartz Oscillator
	Output:	0.1 V rms minimum	
	Accuracy:	±1 part in 10^8	
Signal Generator	Frequency Range:	10 Hz to 10 MHz	Hewlett-Packard Model 651B Test Oscillator
	Output:	0.1 V rms minimum	
	Signal to Noise Ratio:	40dB minimum	

5-7. Units and Decimal Placement

5-8. Check the units and decimal placement of the readout according to figure 5-1. Figure 1-1 shows the unit and decimal placement for different combinations of TIME BASE/MULTIPLIER and FUNCTION switch positions.

TIME BASE	MULTIPLIER	FUNCTION															
		Time		Ratio		Per.Av.		Period		Freq.		Count Start		Count Stop		EXT	
		Unit	Deci Place	Unit	Deci Place	Unit	Deci Place	Unit	Deci Place	Unit	Deci Place	Unit	Deci Place	Unit	Deci Place	Unit	Deci Place
0.1 μsec		μsec	1	*	–	*	–	μsec	1	*	–	–	–	–	–	–	–
1.0 μsec	1	μsec	–	–	–	μsec	1	μsec	–	MHz	–	–	–	–	–	–	–
10 μsec	10	msec	2	–	1	μsec	2	msec	2	MHz	1	–	–	–	–	–	–
0.1 msec	10^2	msec	1	–	2	μsec	3	msec	1	MHz	2	–	–	–	–	–	–
1.0 msec	10^3	msec	–	–	3	nsec	1	msec	–	kHz	–	–	–	–	–	–	–
10 msec	10^4	sec	2	–	4	nsec	2	sec	2	kHz	1	–	–	–	–	–	–
0.1 sec	10^5	sec	1	–	5	nsec	3	sec	1	kHz	2	–	–	–	–	–	–
1.0 sec	10^6	sec	-	–	6	nsec	4	sec	–	Hz	–	–	–	–	–	–	–
10 sec	10^7	ksec	2	–	7	nsec	5	ksec	2	Hz	1	–	–	–	–	–	–
EXT.		–	–	–	-	–	–	–	–	–	–	–	–	–	–	–	–

REMARKS

The sketch below shows the numbers allocated to decimal point positions listed in the table above.

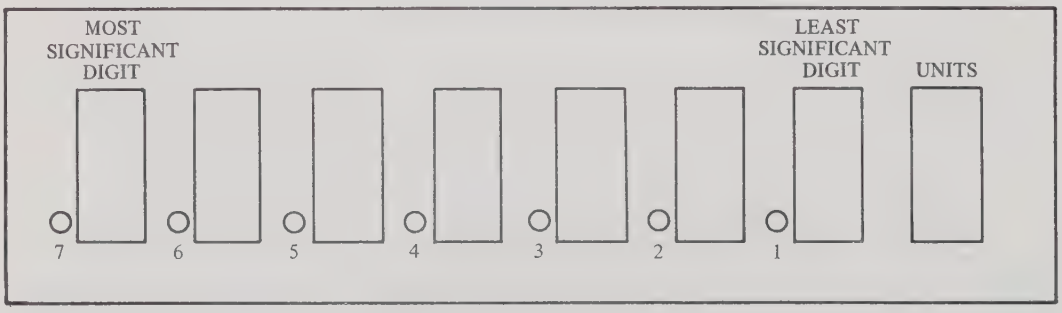


Figure 5-1. Unit and Decimal Placement Chart

5-9. **Frequency Measurement**

5-10. To check the performance of the frequency measurement, proceed as follows:

a. Set front panel controls to the following positions:

FUNCTION switch	FREQ
A-B Reverse switch	A
COM-SEP switch	SEP
MEMORY switch	ON
DISPLAY TIME control	minimum display time
ATTENUATOR A switch	X1 AC
TIME BASE switch	10 μsec

b. Apply a 0.1 V rms, 12.5 MHz signal to INPUT A connector.

c. Vary TRIGGER LEVEL A control. The readout should display 12.5 MHz ±0.1 MHz.

d. Apply a 1 V rms, 1.0 kHz signal to INPUT A connector.

e. Decrease the amplitude of the signal until the threshhold of count-no count is reached. The p-p amplitude should be approximately 100 mV.

f. Repeat steps 1 through 5 for channel B.

g. Set COM-SEP switch to TEST.

h. Set TIME BASE switch to the following positions: 10 μsec, 0.1 msec, 10 msec, 0.1 sec, and 1.0 sec. The readout should be: 1.0 MHz ±0.1 MHz, 1.00 MHz ±0.01 MHz, 1000.0 kHz ±0.1 kHz, 1000.00 kHz ± 0.01 kHz, and 1000000 Hz ±1 Hz.

5-11. **Period Measurement**

5-12. To check the performance of the period measurement, proceed as follows:

a. Set front panel controls to the following positions:

FUNCTION switch	PERIOD
A-B Reverse switch	A
COM-SEP switch	SEP
MEMORY switch	ON
ATTENUATOR A switch	X1AC
TRIGGER LEVEL A control	0 V
DISPLAY TIME control	minimum
TIME BASE switch	0.1 μsec

b. Apply a 1 V rms, 2 MHz signal to INPUT A connector. Display should be 0.5 μsec ±0.1 μsec.

c. Apply a 0.1 V rms, 1 kHz signal to INPUT A connector. The display should be 1000.0 μsec ±0.3 μsec.

d. Repeat steps 1 through 3 for channel B.

e. Set COM-SEP switch to TEST. The reading should be 1.0 μsec ±0.1 μsec.

5-13. **Period Average Measurement**

5-14. To check the performance of the period average measurement, proceed as follows:

a. Set front panel controls to the following positions:

FUNCTION switch	PER.AV.
A-B Reverse switch	A
COM-SEP switch	SEP
MEMORY switch	ON
ATTENUATOR A switch	X1AC
TRIGGER LEVEL A control	0 V
DISPLAY TIME control	minimum display time
MULTIPLIER switch	10^2

b. Apply a 0.1 V rms, 1 kHz signal to INPUT A connector. The display should be 1000.000 μsec ±0.03 μsec.

c. Repeat steps 1 and 2 for channel B.

d. Set COM-SEP switch to TEST.

e. Set MULTIPLIER switch to the following positions: 1, 10^2, 10^3 and 10^5. The reading should be: 1.0 μsec ±0.1 μsec, 1.000 μsec ±0.001 μsec, 1000.0 nsec ±0.1 nsec, and 1000.000 nsec ±0.001 nsec.

5-15. **Frequency Ratio Measurement**

5-16. To check the performance of the frequency ratio measurement, proceed as follows:

a. Set front panel controls to the following positions:

FUNCTION switch	RATIO
A-B Reverse switch	A/B
COM-SEP switch	SEP
MEMORY switch	ON
ATTENUATOR A switch	X1AC
ATTENUATOR B switch	X1AC
TRIGGER LEVEL A control	0 V
TRIGGER LEVEL B switch	0 V
DISPLAY TIME control	minimum display time

b. Apply a 0.1 V rms, 1-2.5 MHz signal to INPUT A connector.

c. Apply a 0.1 V rms, 2 MHz signal to INPUT B connector.

d. Set MULTIPLIER switch to: 10^2, 10^3 and 10^6. The display should be: 6.25 ±0.01, 6.250 ±0.001, and 6.250000 ±0.000001.

e. Set COM-SEP switch to TEST.

f. Set MULTIPLIER switch to: 10, 10^2, 10^3 and 10^6. The display should be: 1.0 ±0.1, 1.00 ±0.01, 1.000 ±0.001, and 1.000000 ±0.000001.

5-17. **Time Interval Measurement**

5-18. To check the performance of the time interval measurement, proceed as follows:

a. Set front panel controls to the following positions:

FUNCTION switch	TIME
COM-SEP switch	COM
MEMORY switch	ON
ATTENUATOR A switch	X1AC
ATTENUATOR B switch	X1AC
INPUT A SLOPE switch	+
INPUT B SLOPE switch	-
DISPLAY TIME control	minimum display time
TIME BASE switch	0.1 μsec

b. Apply a 1 V rms; 1 kHz signal to INPUT A connector.

c. Set A-B Reverse switch to A→B and then to B→A. The sum of the time A→B plus B→A should be equal to 1000.0 μsec ±0.2 μsec.

5-19. **PERIODIC MAINTENANCE**

5-20. The Model 8200 requires little periodic maintenance. The procedures in the paragraphs that follow may be used when maintenance is performed on a regular basis.

5-21. **Inspection**

5-22. Remove the top and bottom covers from the instrument. Inspect the chassis and mounted components for damage, signs of overheating, etc. Remove circuit boards and inspect for signs of failure. Using low pressure, dry, compressed air, blow out any dust accumulation.

5-23. Rotate front panel controls through their full range, noting any binding or rough action.

5-24. Following inspection replace all circuit boards and covers. Make performance check detailed in paragraphs 5-6 through 5-18.

5-25. **Air Filter**

5-26. Clean air filter as follows:

a. Remove four screws and frame holding filter element.

b. Remove filter element.

c. Wash filter in warm water—detergent solution.

d. Dry filter thoroughly and replace.

NOTE

Do not use coating compound on filter. Filter is designed to be used dry.

5-27. ALIGNMENT PROCEDURE

5-28. Paragraphs 5-29 through 5-38 detail the alignment procedure used to calibrate the Model 8200 for correct readout on all ranges. Figure 5-2 shows the location of alignment controls and test points.

5-29. Power Supply Alignment

5-30. Adjust each power supply as follows:

a. Monitor TP2 on the regulator and rectifier board A5 with the Fairchild DVM. Adjust R13 on A5 until the DVM reads +12.0 ±0.2 V.

b. Monitor TP3 on A5 with the DVM. Adjust R23 on A5 until the DVM reads -12.0 ±0.2 V.

c. Monitor TP1 on A5 with the DVM. Adjust R3 until the DVM reads +2 ±0.05 V.

d. After half an hour warm up time Monitor TP5 on A5 with the DVM. Adjust R42 until the DVM reads +27 V ±0.2 V.

5-31. 10 MHz Multiplier Alignment

5-32. Adjust the 10 MHz multiplier as follows:

a. Set FUNCTION switch on PER.AV.

b. Set COM-SEP switch on TEST.

c. Set TIME BASE switch at 10^4 (or 10 msec).

d. Adjust L1 on A7 until the readout display reads 1000.00 nsec. (The slug should be located near the middle of the coil form.)

e. Monitor pin 25 on A7 with the oscilloscope. Further adjust L1 on A7 until a maximum amplitude output at pin 25 is obtained.

5-33. Channel A Balance Adjustment

5-34. Proceed as follows:

a. Apply 0.1 V rms, 5 MHz signal to INPUT A connector.

b. Ground TRIGGER LEVEL A control (clip wiper of control to ground).

c. Connect scope probe to pin 13 on A11.

d. Adjust R17 on A14 and simultaneously operate the SLOPE A switch for 50% duty cycle for both slope positions.

e. Remove ground from TRIGGER LEVEL A control. Use the DVM to measure the voltage on the wiper of the TRIGGER LEVEL A control. Rotate the control shaft until this voltage is zero. Adjust the TRIGGER LEVEL A control knob on the shaft so that it is pointing straight up.

5-35. Channel B Balance Adjustment

5-36. Proceed as follows:

a. Apply 0.1 V rms, 5 MHz, signal to INPUT B connector.

b. Ground TRIGGER LEVEL B control (clip wiper of control to ground).

c. Connect scope probe to pin 19 on A11.

d. Adjust R17 on A15 and simultaneously operate the SLOPE B switch for 50% duty cycle for both slope positions.

e. Remove ground from TRIGGER LEVEL B control. Use the DVM to measure the voltage on the wiper of the TRIGGER LEVEL B control. Rotate the control shaft until this voltage is zero. Adjust the TRIGGER LEVEL B control knob on the shaft so that it is pointing straight up.

5-37. 1.0 MHz Oscillator Adjustment

5-38. To adjust the 1.0 MHz oscillator to better than 2 parts in 10^8 after 24 hours of warm-up time (this assumes that the oscillator has been aging in a rack for more than a month) proceed as follows:

a. Apply a standard 1 MHz signal to EXT. HORIZONTAL INPUT of the oscilloscope.

b. Connect the 1 MHz time base from the rear panel to the VERTICAL input connector of the oscilloscope.

c. Use a nonmetallic alignment tool and adjust the screw for the 1 MHz adjustment on the rear panel until the trace on the screen of the oscilloscope stops rotating.

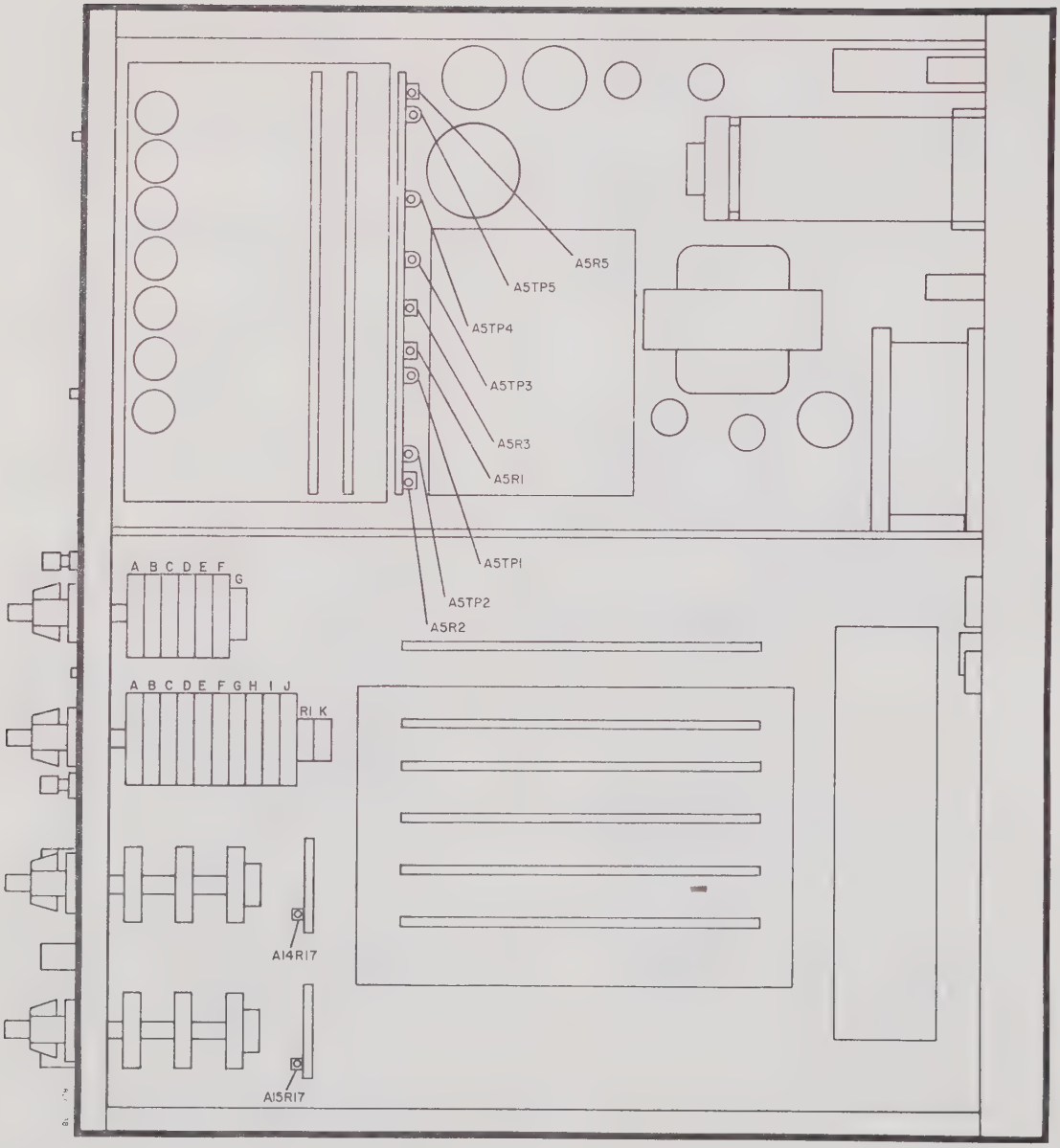


Figure 5-2. Adjustment Controls and Test Points

5-37. COMPONENT LOCATION AND SCHEMATIC DIAGRAMS

5-38. Figures 5-2 through 5-36 show the location of all components in the instrument and schematic diagrams. Included are diagrams of optional equipment.

5-39. LOGIC TERMS

5-40. Table 5-3 is a glossary of the logic terms used in the logic schematics listing signal definition and source. The signals appear as barred or unbarred terms on the schematics. An unbarred signal is normally high (+1.5 V) and goes to ground when the particular logic function is true. A barred term is the reverse.

Table 5-2. Glossary of Logic Signals

Signal Name	Definition	Source
"A" MARKER OUT	Signal with 10 μsec pulse width at the frequency of the input signal at channel A.	A11
"A" SIGNAL OUT	Output from shaper A to function select logic.	A11
"A" TRIGGER OUT	Output from shaper A to front panel.	A11
"B" MARKER OUT	Signal with 10 μsec pulse width at the frequency of the input signal at channel B.	A11
"B" SIGNAL	Output signal from shaper B to function select logic.	A11
"B" TRIGGER OUT	Output signal from shaper B to front panel.	A11
DHz, Dk, Dm, Dn, DS, DM, Dμ, D*	Driver lines for units.	A6
DP1D through DP7D	Driver lines for decimal placement.	A6
DP1S through DP7S	Signal lines for decimal placement.	Front Panel
DZa, DZb, DZc, DZd	BCD outputs for decimal placement.	A6
END OF COUNT	Signal indicating end of count. Used as print command signal.	A9
F0 through F7	Time base select lines.	Front Panel
F8	Signal line to inhibit the 1 MHz signal passing into the decade dividers.	Front Panel
GATE LAMP DRIVE	Driver signal to gate lamp.	A9
GATE LAMP INHIBIT	Not Used.	A9
GATE CONTROL SIGNAL	Logic signal to open the count gate.	A9
MANUAL GATE CONTROL	Logic signal to open the count gate manually.	Front Panel
MANUAL GATE SELECT	Logic signal indicating on count mode.	Front Panel
MANUAL OR REMOTE RESET	See RESET.	(Data Logger)

Table 5-2. Glossary of Logic Signals (Continued)

Signal Name	Definition	Source
MEMORY CONTROL	Logic signal that enables CμL959 to receive readout data from CμL958.	Front Panel
RESET	150 μsec one-shot that resets decade counters, time base and the gate control logic.	A9
RESET INHIBIT	Inhibits display time generator.	A9
S1 through S8	Function select lines.	Front Panel
SET & INHIBIT	20 msec one-shot to gate control logic and time base generator. Inhibits the counters.	A9
SLOPE	Signal line controlling the slope on which an input signal triggers.	Front Panel
START	Logic signal controlling start of counting	A10
STB	Shaped input signal to decade dividers.	A10
STB/N	Selected time base divided by N. Output from the time base.	A8
STOP	Logic signal controlling stop of counting.	A10
TRANSFER	Output of 15 msec one-shot that transfers data from CμL958 to CμL959.	A9
TRANSFER INHIBIT	Not used.	A9
UZa, UZb, UZc, UZd	BCD outputs for units.	A6
Za, Zb, Zc, Zd	BCD outputs for each respective digit 1 through 7.	A3

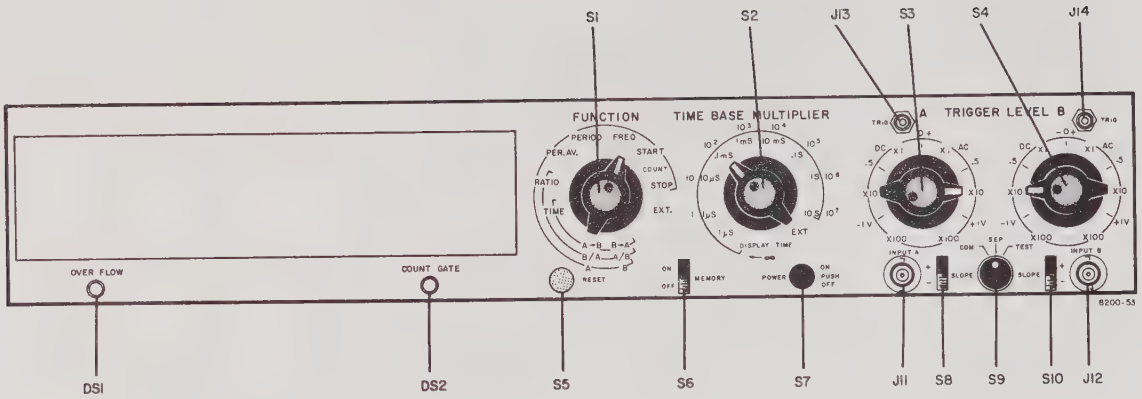


Figure 5-3. Component Location, Front Panel

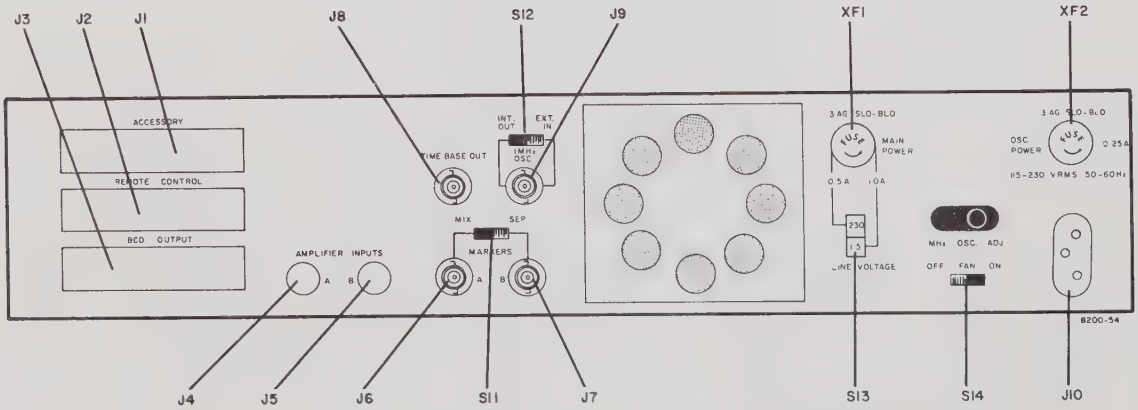


Figure 5-4. Component Location, Rear Panel

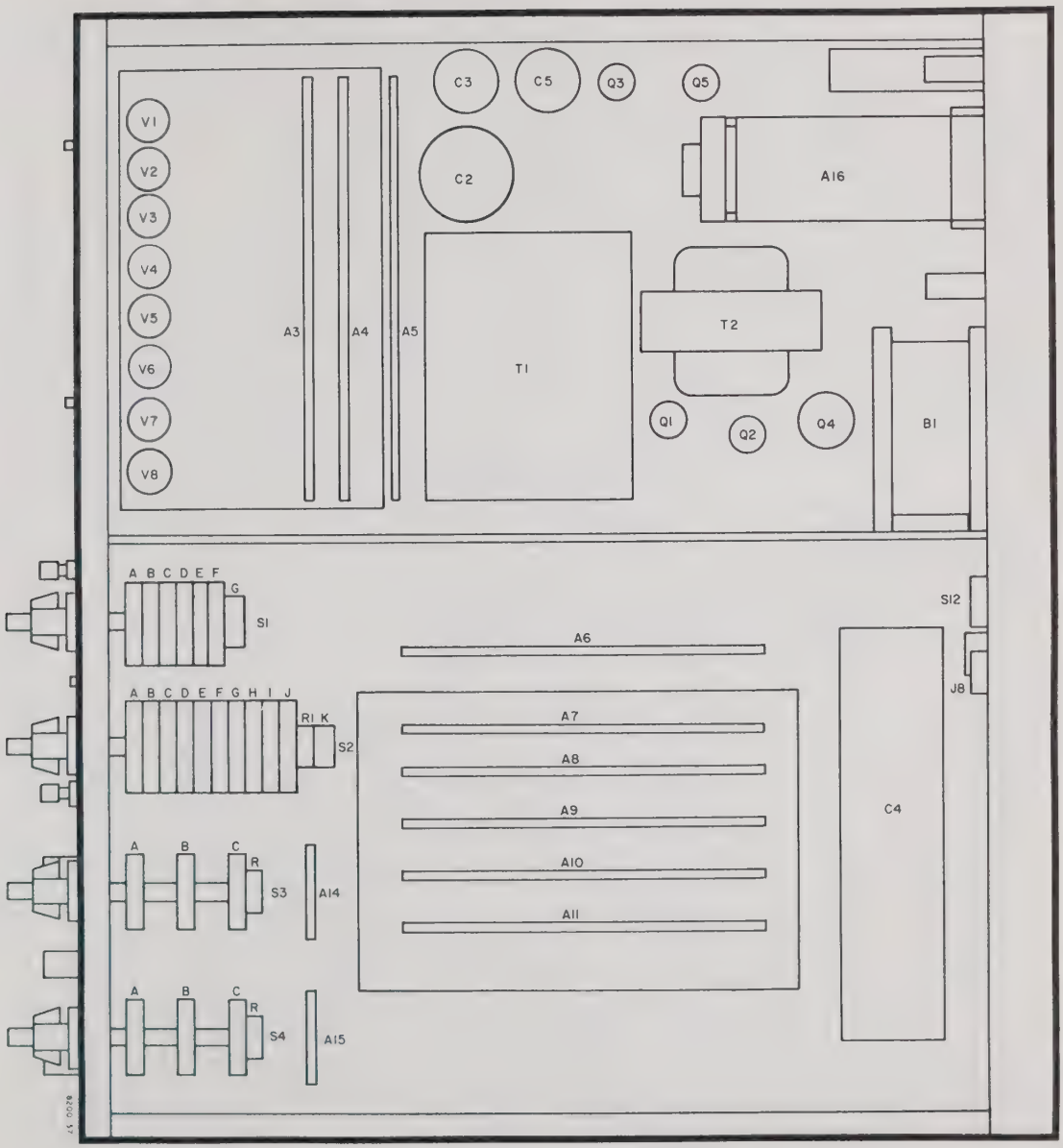


Figure 5-5. Component Location, Main Frame, Top View

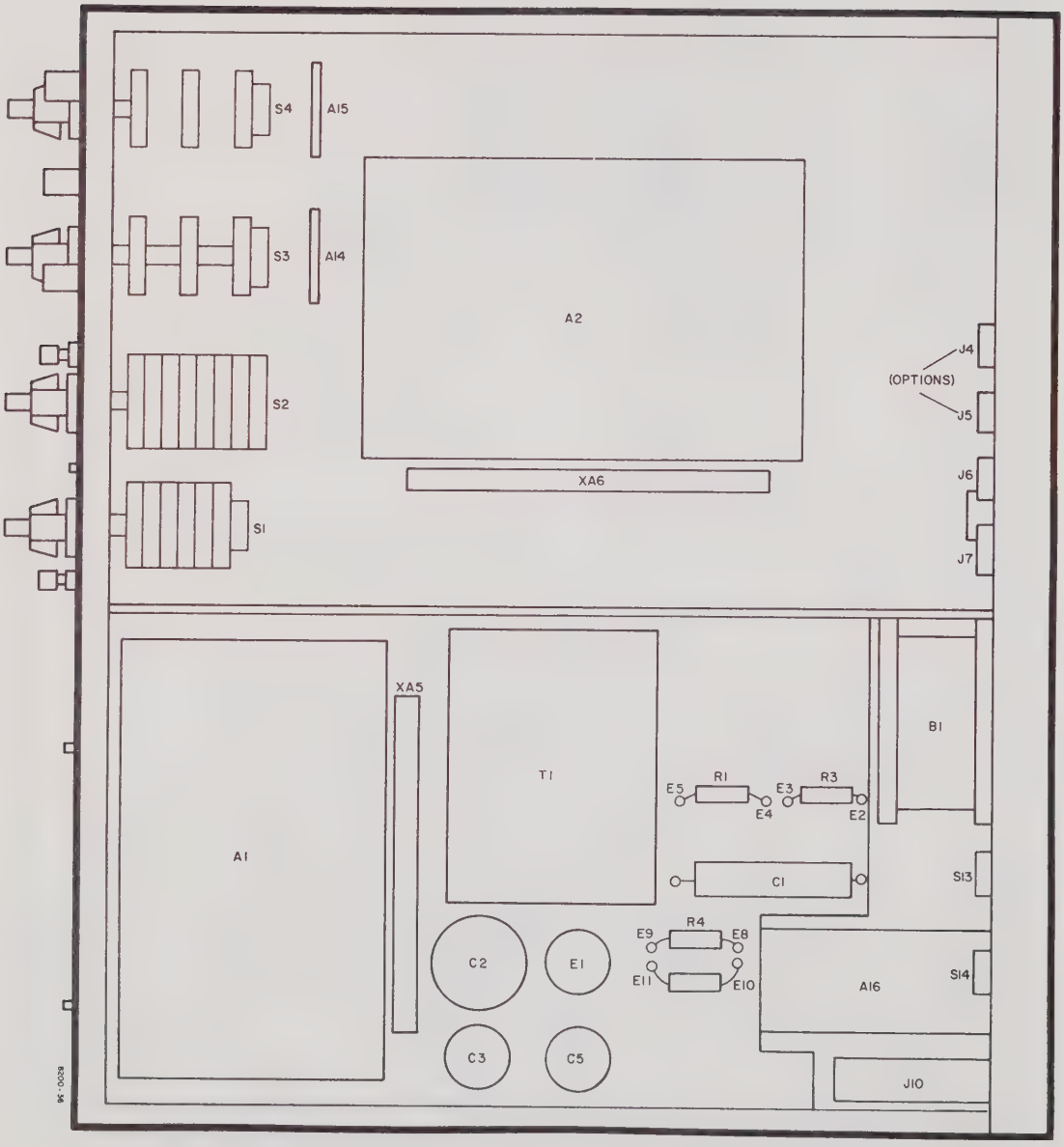
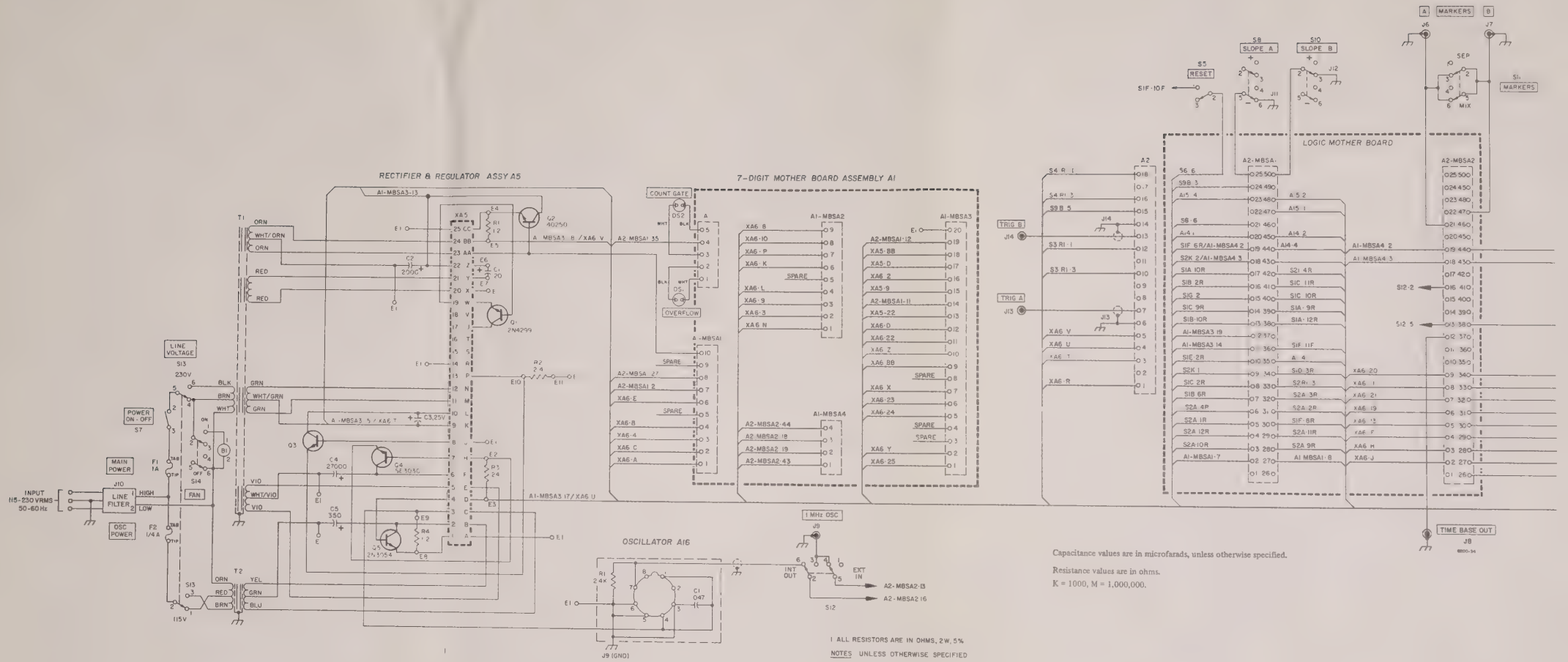


Figure 5-6. Component Location, Main Frame, Bottom View



Capacitance values are in microfarads, unless otherwise specified.

Resistance values are in ohms.
K = 1000, M = 1,000,000.

Figure 5-7. Model 8200 Interconnection Diagram. Sheet 1 of 2

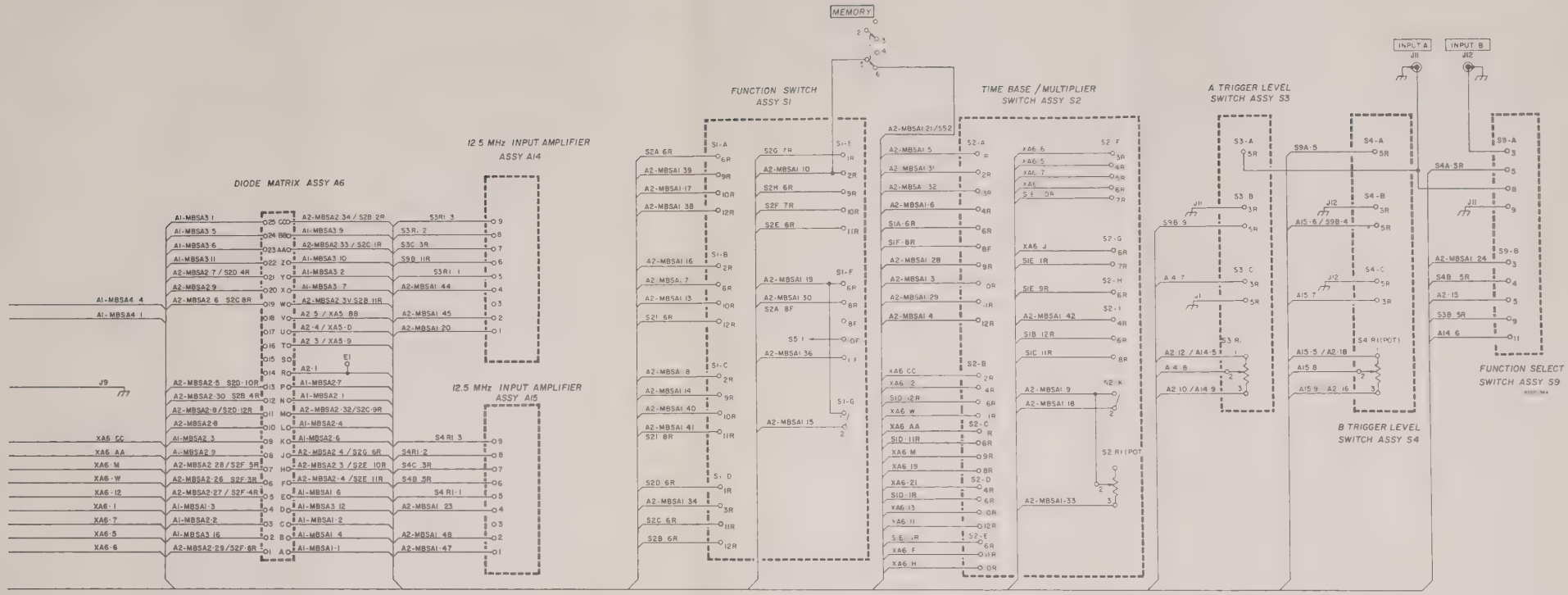

MEMORY
FUNCTION SWITCH ASSY S1
TIME BASE / MULTIPLIER SWITCH ASSY S2
A TRIGGER LEVEL SWITCH ASSY S3
B TRIGGER LEVEL SWITCH ASSY S4
FUNCTION SELECT SWITCH ASSY S9
INPUT A J11
INPUT B J12
12.5 MHz INPUT AMPLIFIER ASSY A14
12.5 MHz INPUT AMPLIFIER ASSY A15
DIODE MATRIX ASSY A6

Figure 5-7. Model 8200 Interconnection Diagram, Sheet 2 of 2

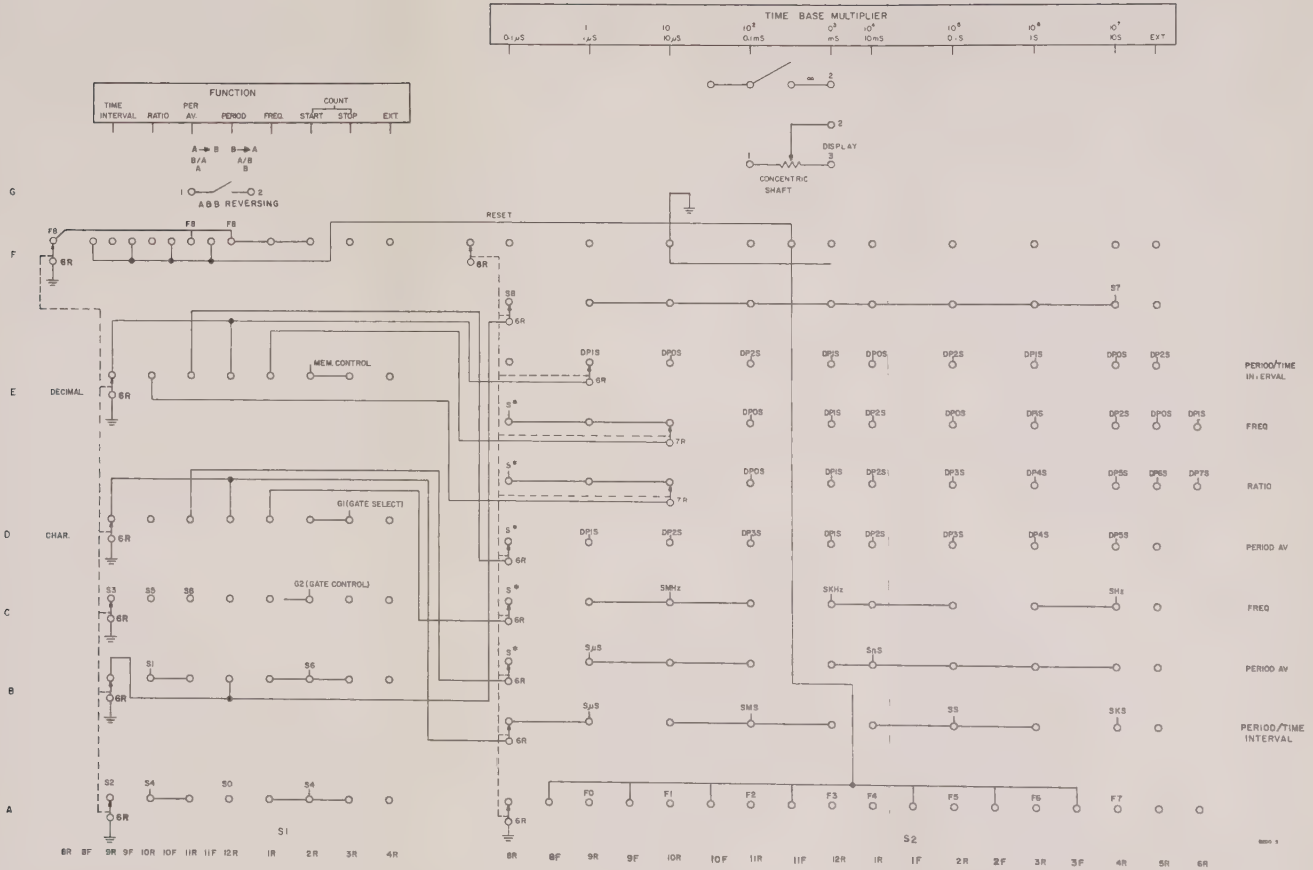


Figure 5-8. Schematic, Switches S1 and S2

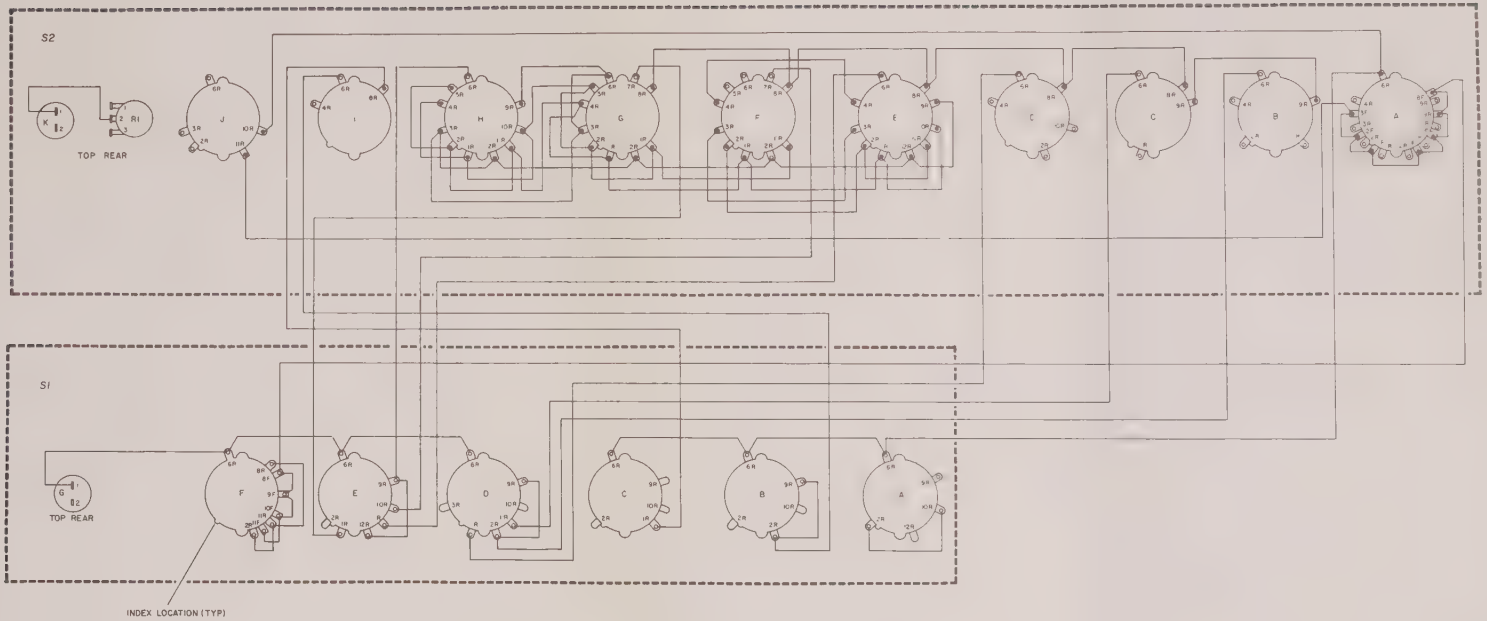
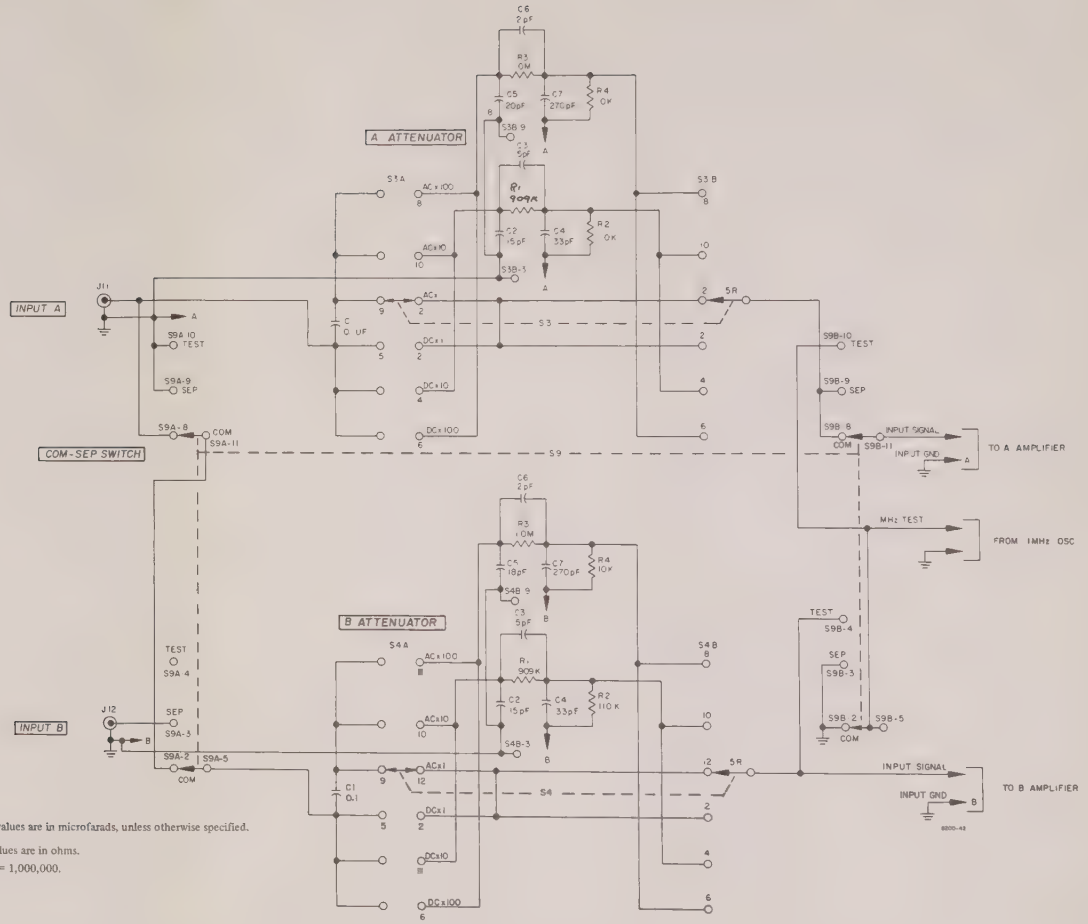


Figure 5-9. Wiring Diagram, Switches S1 and S2



Capacitance values are in microfarads, unless otherwise specified.

Resistance values are in ohms.
K = 1000, M = 1,000,000.

Figure 5-10. Schematic, Switches S3, S4, and S9

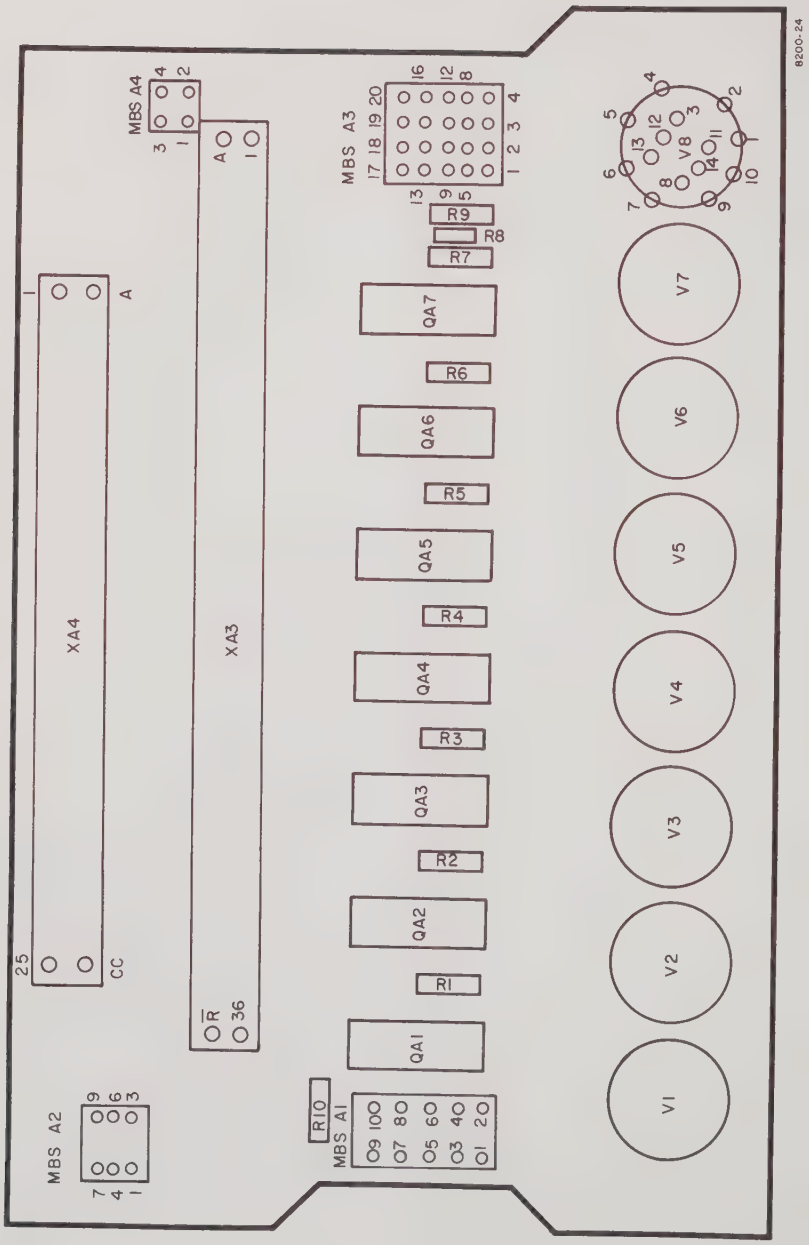


Figure 5-11. Component Location, 7-Digit Mother Board A1

PIN	NUMERAL
1	7
2	5
3	8
4	ANODE
5	1
6	4
7	2
8	6
9	9
10	3
11	DECIMAL
12	NO PIN
13	0
14	INT CONN

NL841 TYP PIN CONNECTIONS

BOTTOM VIEW
PC BOARD

PIN	UNIT
1.	Ω
2.	V
3.	Hz
4.	ANODE
5.	M
6.	m
7.	n
8.	μ
9.	S
10.	A
11.	*
12.	NO PIN
13.	K
14.	INT CONN

NL 828 TYP CONNECTIONS

BOTTOM VIEW
PC BOARD

Capacitance values are in microfarads, unless otherwise specified.

Resistance values are in ohms.
K = 1000, M = 1,000,000.

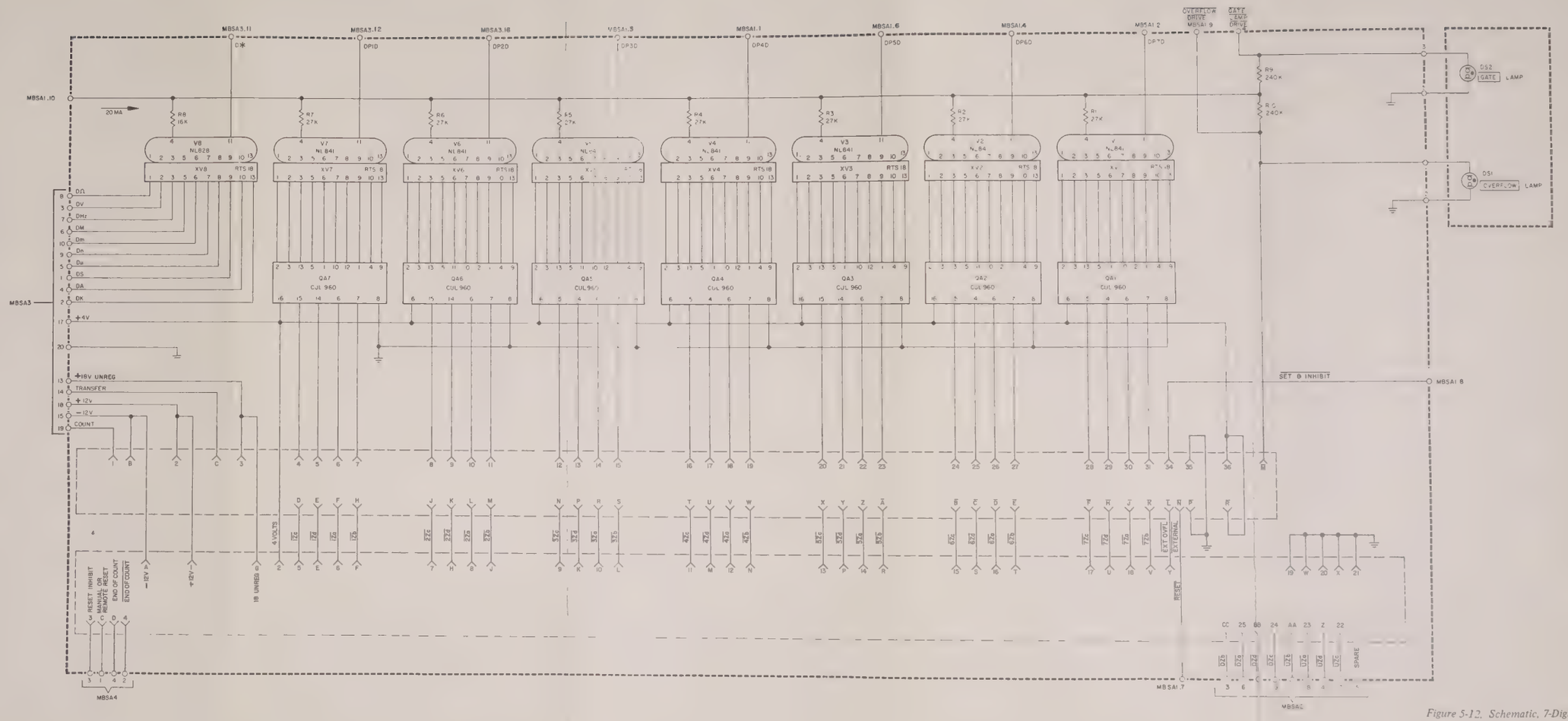


Figure 5-12. Schematic, 7-Digit Mother Board A1

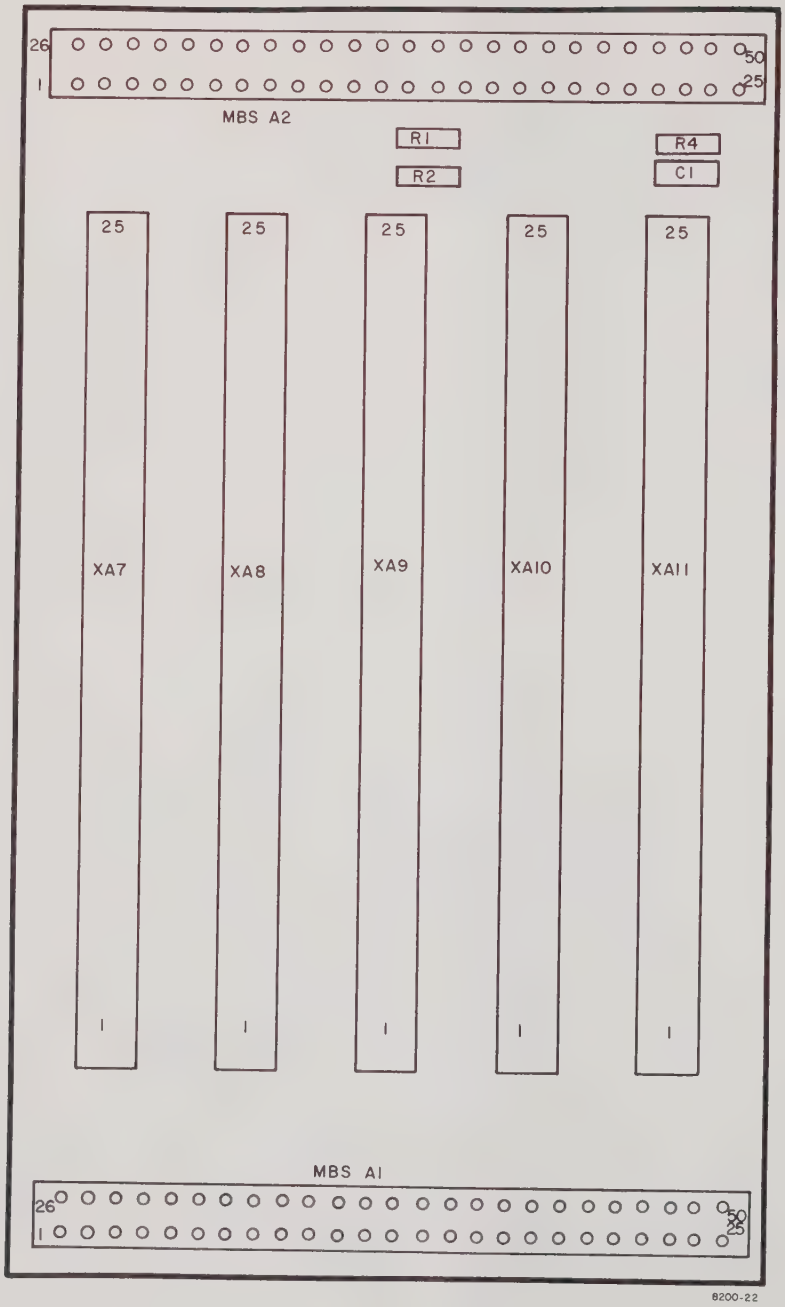
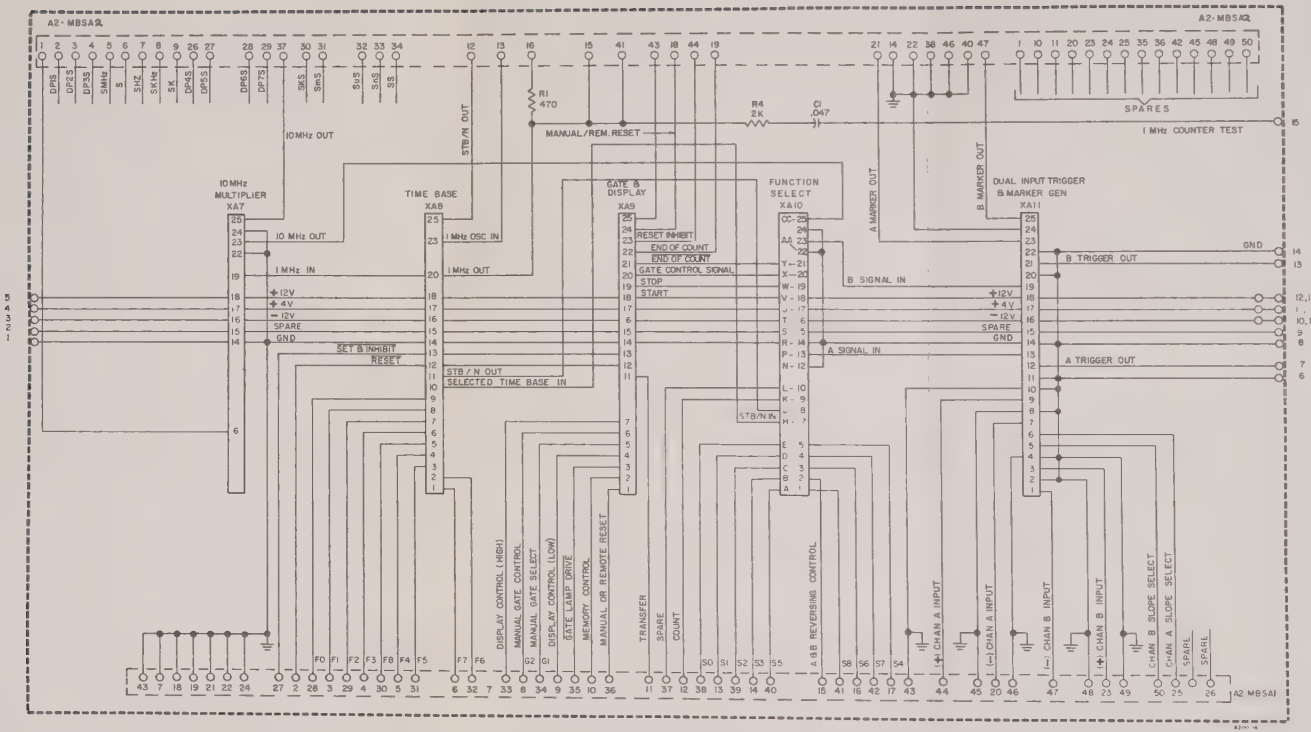


Figure 5-13. Component Location, Logic Mother Board A2



Capacitance values are in microfarads, unless otherwise specified.

Resistance values are in ohms.

K = 1000, M = 1,000,000.

Figure 5-14. Schematic, Logic Mother Board A2

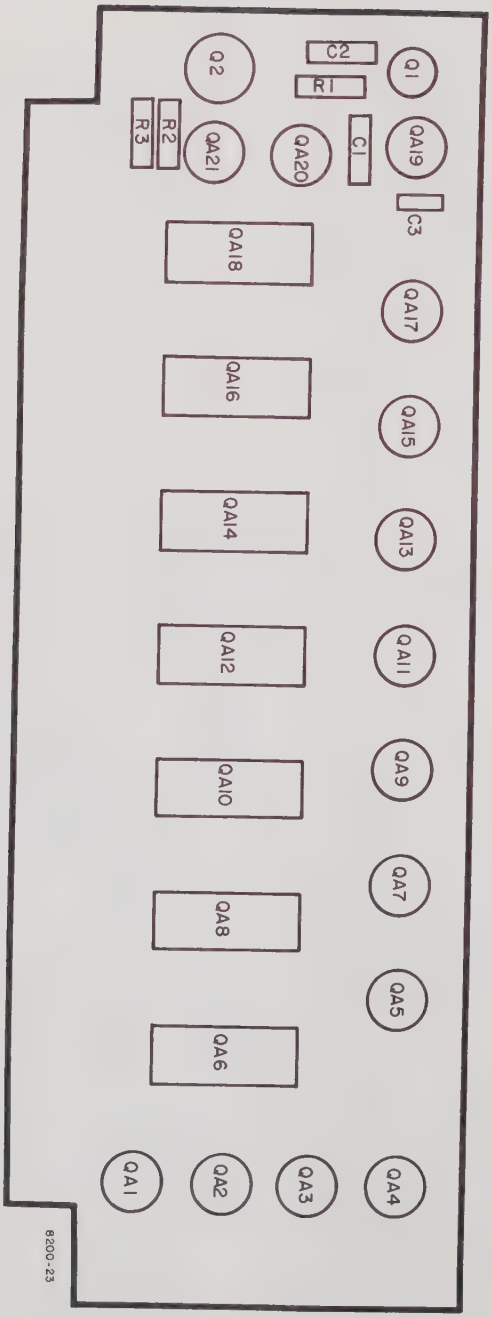
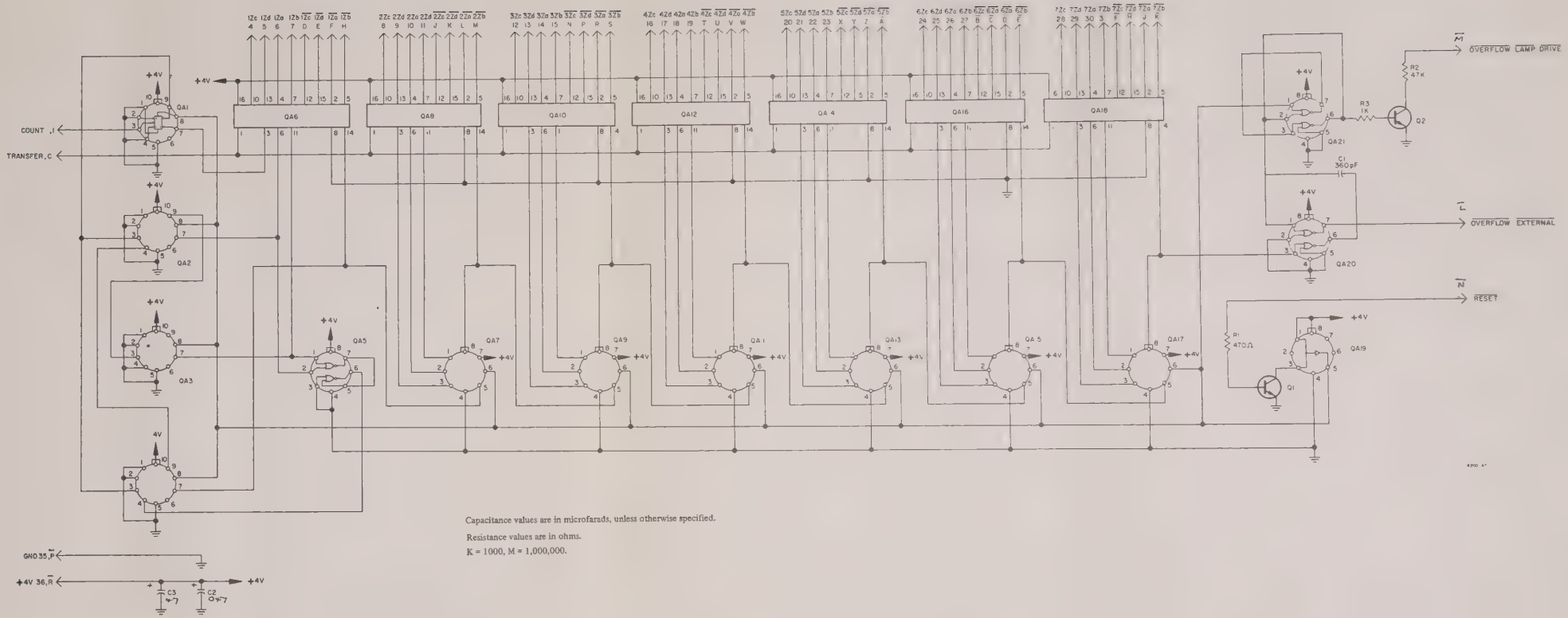


Figure 5-15. Component Location, 7-Digit Decade Counter Assembly A3



Capacitance values are in microfarads, unless otherwise specified.

Resistance values are in ohms.

K = 1000, M = 1,000,000.

Figure 5-16. Schematic, 7-Digit Decade Counter Assembly A3

Errata Sheet
August 1967

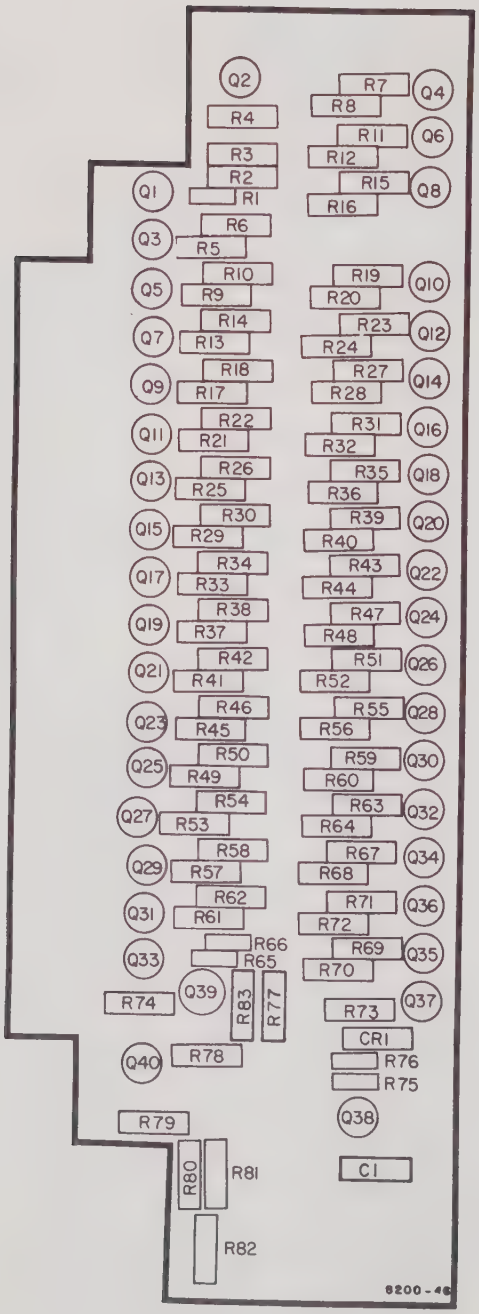


Figure 5-17. Component Location, BCD Inverter Assembly A4–Negative True Logic (Part of Option 02)

Output Output	Code (BCD)	J3 Pin Designation	Remarks
1st Decade (Most Significant Digit)	1 2 4 8	13 14 38 39	
2nd Decade	1 2 4 8	11 12 36 37	
3rd Decade	1 2 4 8	9 10 34 35	
4th Decade	1 2 4 8	7 8 32 33	
5th Decade	1 2 4 8	5 6 30 31	
6th Decade	1 2 4 8	1 4 28 29	
7th Decade (Least Significant Digit)	1 2 4 8	1 2 26 27	
Decimal Point	1 2 4 8	17 18 42 43	
Measurement Units	1 2 4 8	15 16 40 41	
–INHIBIT		47	Signal from printer. Inhibits decade counters from reseting while printer is printing.
– PRINT COMMAND		48	Signal to initiate printer to print at end of count
– REF		24	Negative voltage reference. Less than –2 V.
+ REF		25	Positive voltage reference. Greater than +8 V.
GND		50	Ground

Digit Decoding

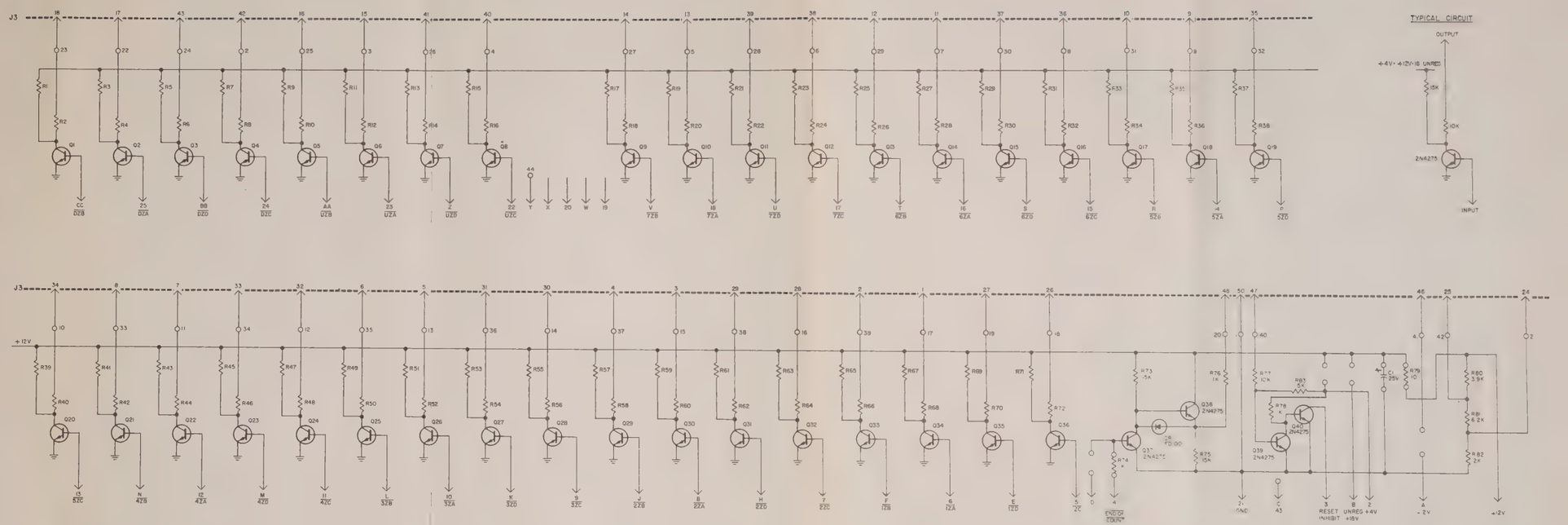
Digit	Print Out	Binary Code 1	2	4	8
0	0	0	0	0	0
1	1	1	0	0	0
2	2	0	1	0	0
3	3	1	1	0	0
4	4	0	0	1	0
5	5	1	0	1	0
6	6	0	1	1	0
7	7	1	1	1	0
8	8	0	0	0	1
9	9	1	0	0	1

Decimal Point Decoding

Decimal Point	Print Out	Binary Code 1	2	4	8
0	0	0	0	0	0
1	1	1	0	0	0
2	2	0	1	0	0
3	3	1	1	0	0
4	4	0	0	1	0
5	5	1	0	1	0
6	6	0	1	1	0
7	7	1	1	1	0

Unit Decoding

Unit	Print Out	Binary Code 1	2	4	8
	0	0	0	0	0
sec	1	1	0	0	0
msec	2	0	1	0	0
μsec	3	1	1	0	0
nsec	4	0	0	1	0
ksec	5	1	0	1	0
	6	0	1	1	0
kHz	7	1	1	1	0
Hz	8	0	0	0	1
MHz	9	1	0	0	1
*		0	1	0	1



Capacitance values are in microfarads, unless otherwise specified.

Resistance values are in ohms.
K = 1000, M = 1,000,000.

(Part of Option 02)

Figure 5-18. Schematic, BCD Inverter Assembly A4–Negative True Logic

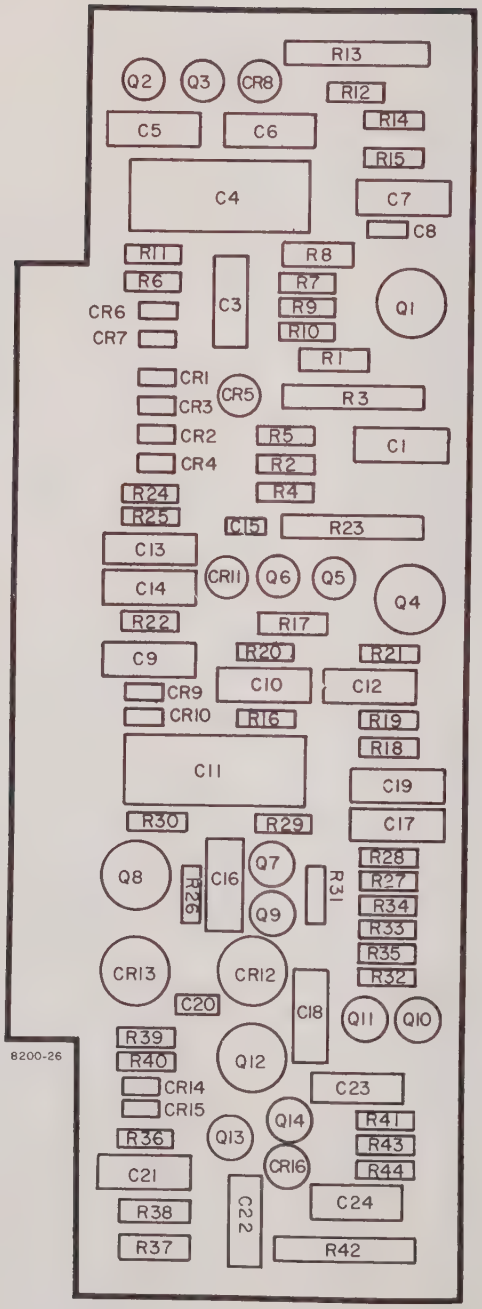
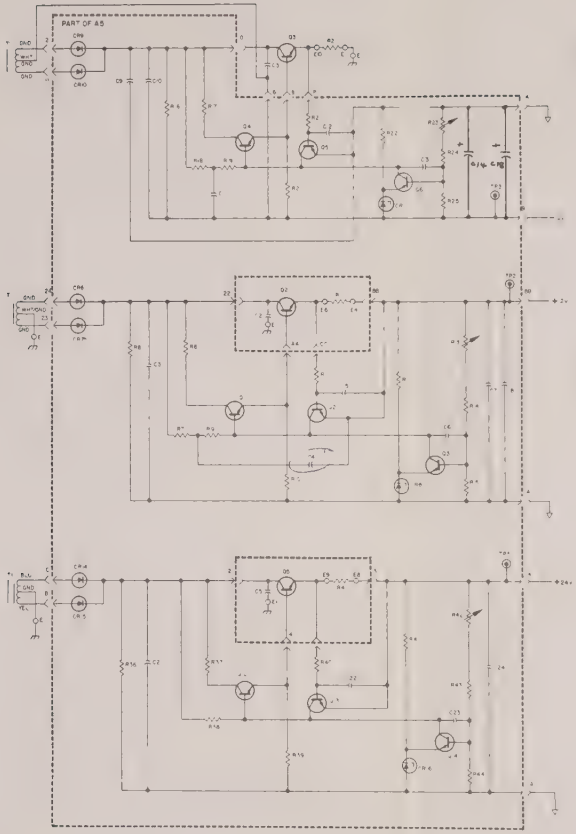


Figure 5-19. Component Location, Rectifier and Regulator Assembly A5


PART OF A5
GND
CR9
CR10
Q3
Q4
Q5
Q6
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21
C22
C23
C24
C25
C26
C27
C28
C29
C30
C31
C32
C33
C34
C35
C36
C37
C38
C39
C40

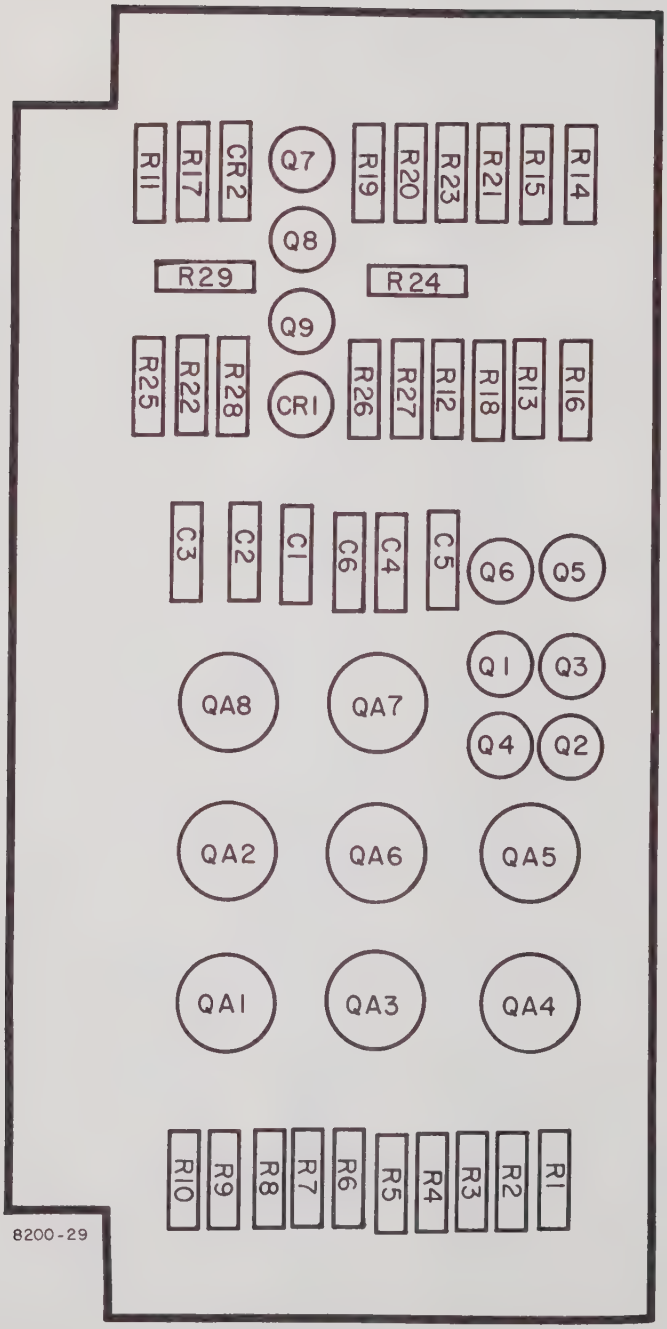
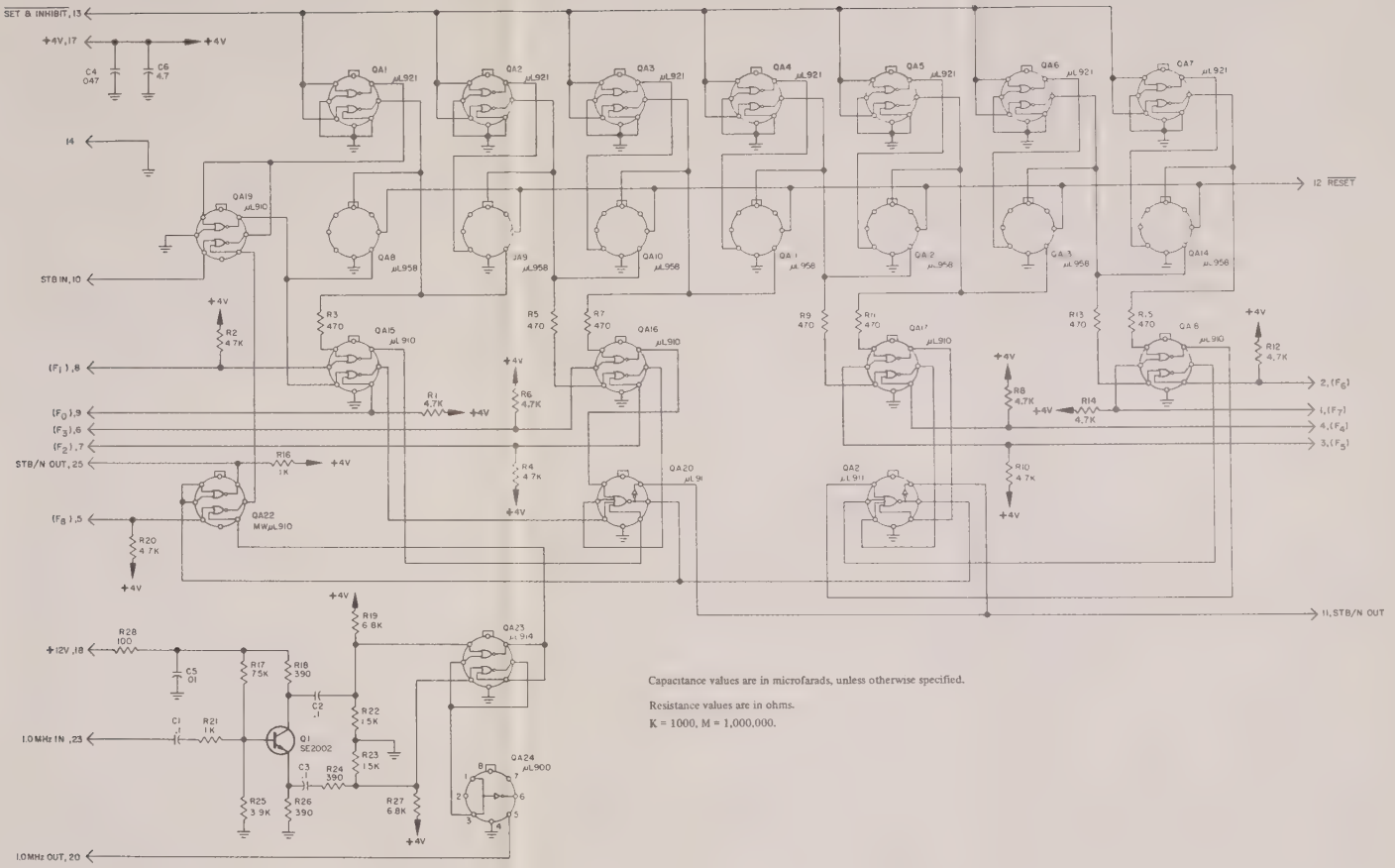


Figure 5-29. Component Location, Function Select Logic Assembly A10



Capacitance values are in microfarads, unless otherwise specified.

Resistance values are in ohms.
K = 1000, M = 1,000,000.

Figure 5-26. Schematic, Time Base Assembly A8

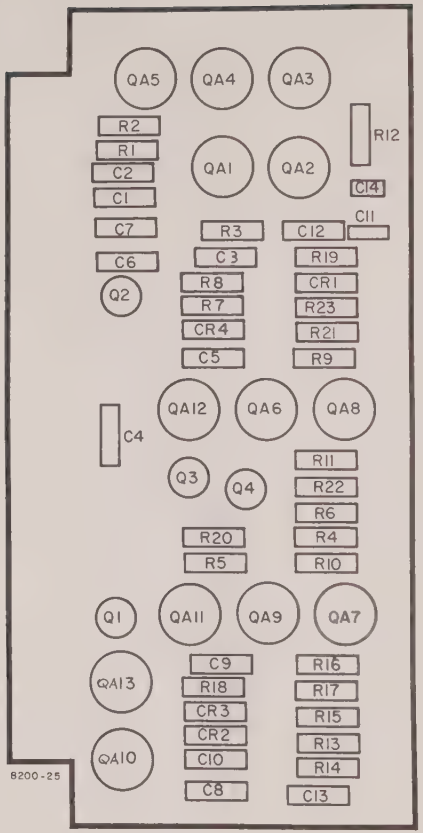


Figure 5-27. Component Location, Gate and Display Logic Assembly A9

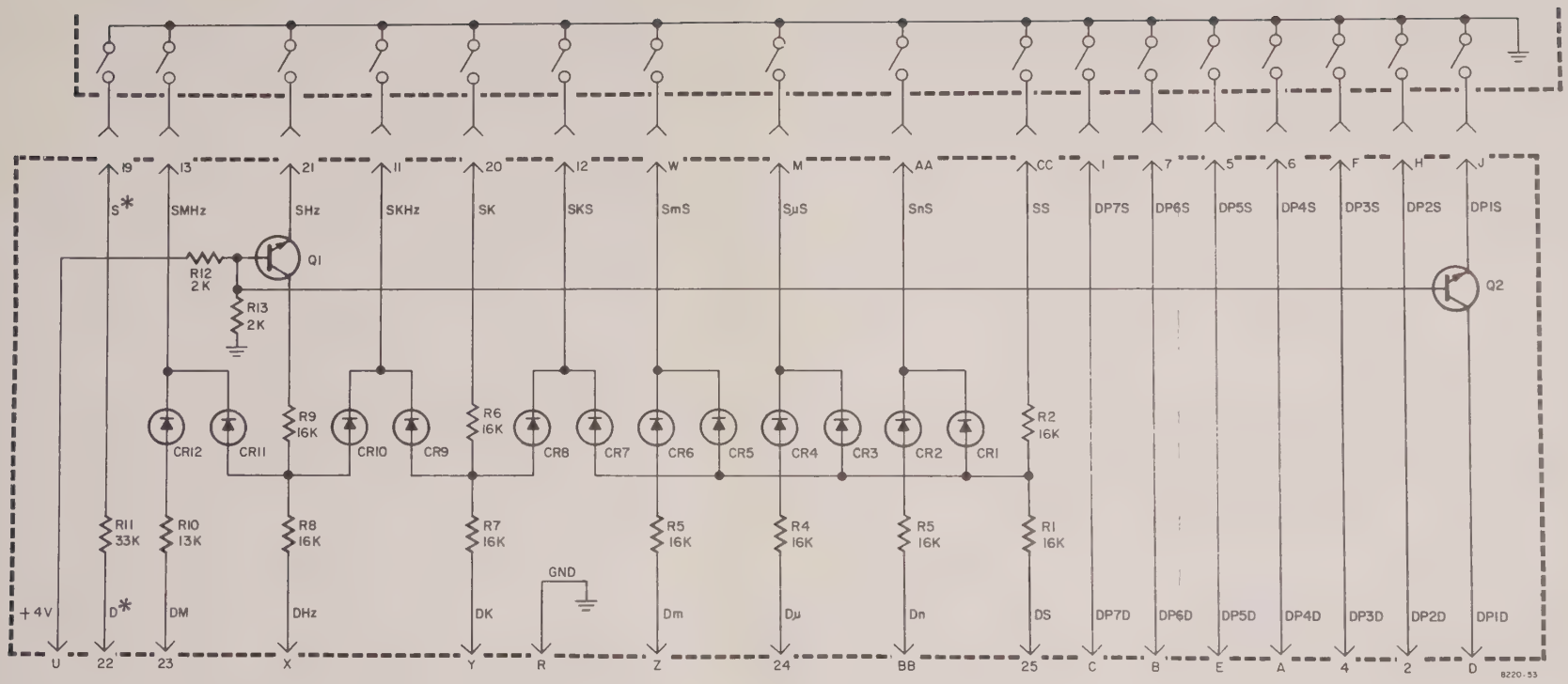


Figure 5-22, Schematic, Diode Matrix Assembly A6

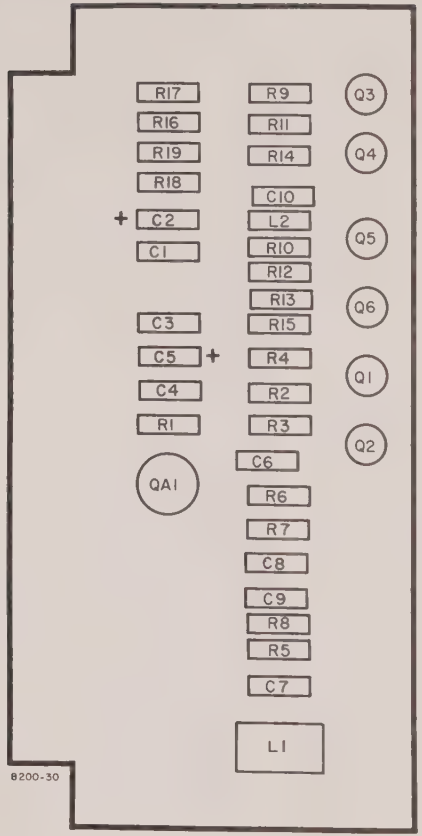
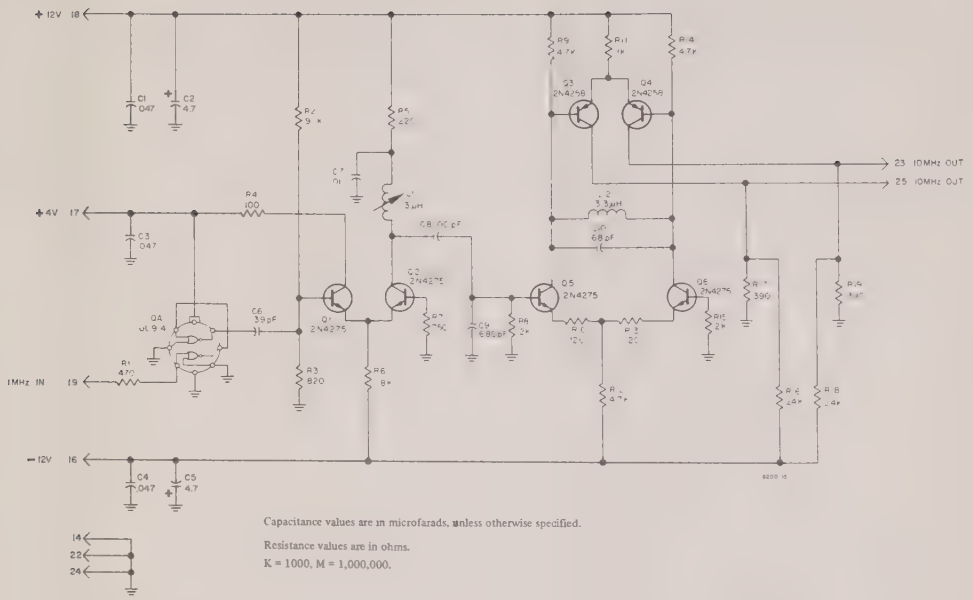


Figure 5-23. Component Location, 10 MHz Multiplier Assembly A7



Capacitance values are in microfarads, unless otherwise specified.

Resistance values are in ohms.
K = 1000, M = 1,000,000.

Figure 5-24. Schematic, 10 MHz Multiplier Assembly A7

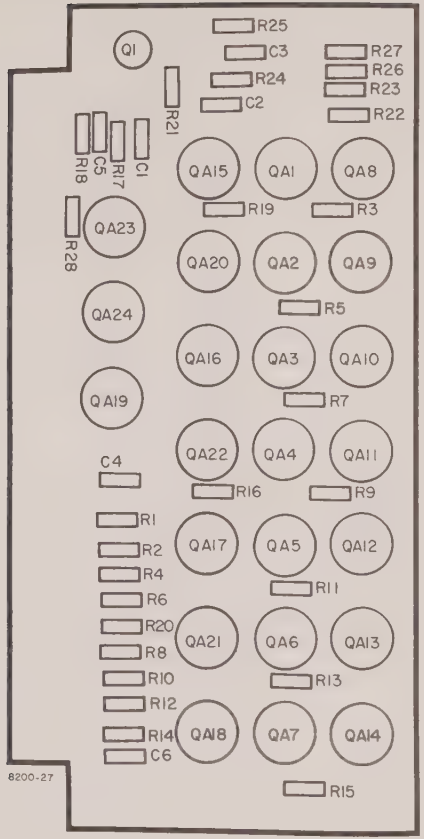
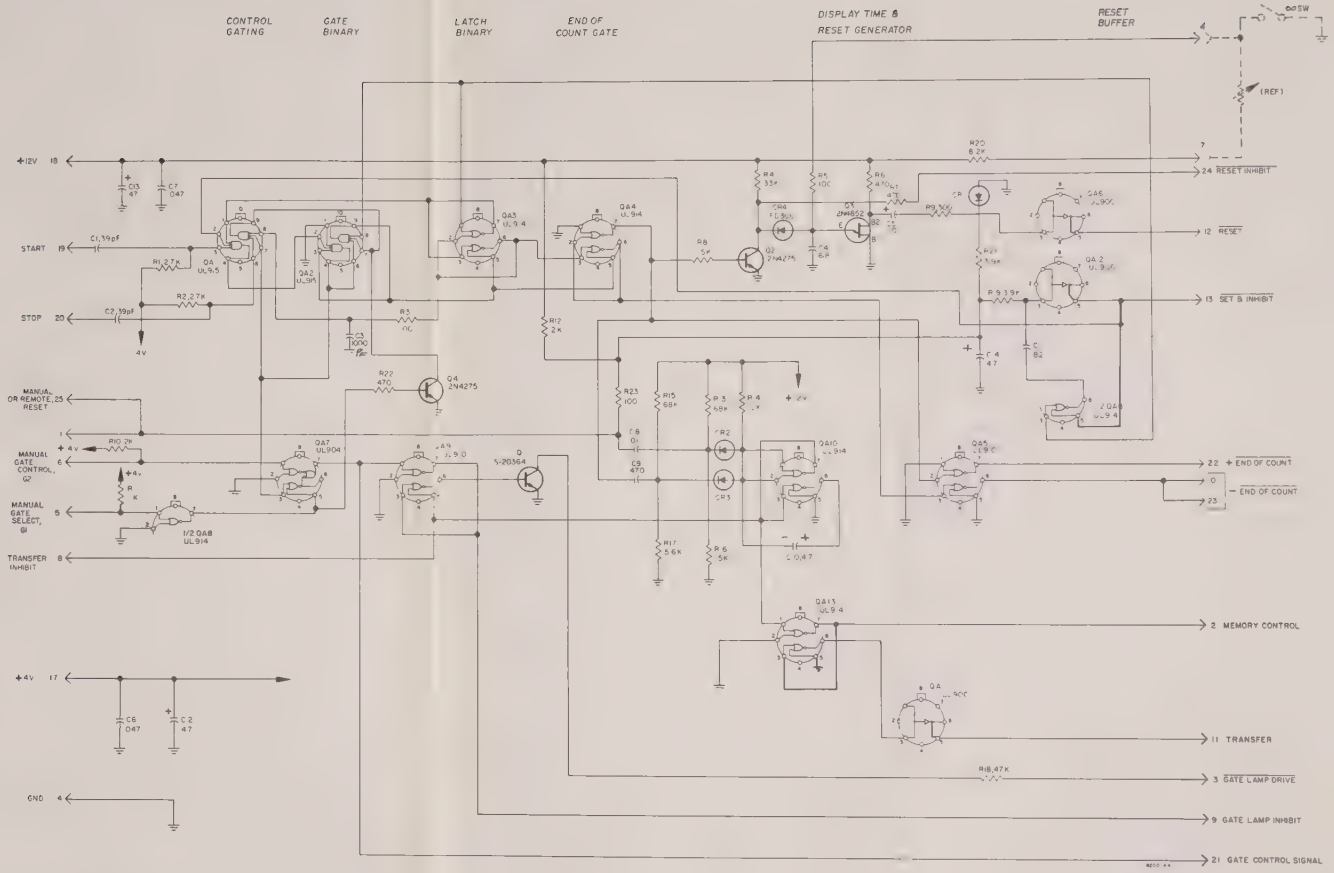


Figure 5-25. Component Location, Time Base Assembly A8



Capacitance values are in microfarads, unless otherwise specified.

Resistance values are in ohms.
K = 1000, M = 1,000,000.

Figure 5-28. Schematic, Gate and Display Logic Assembly A9

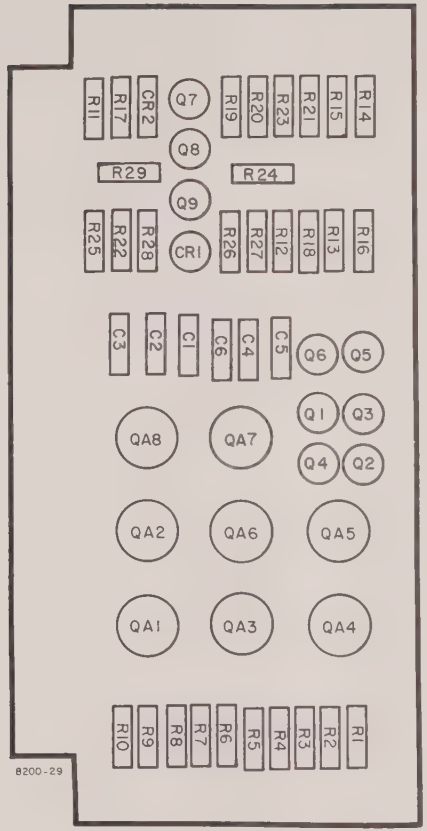
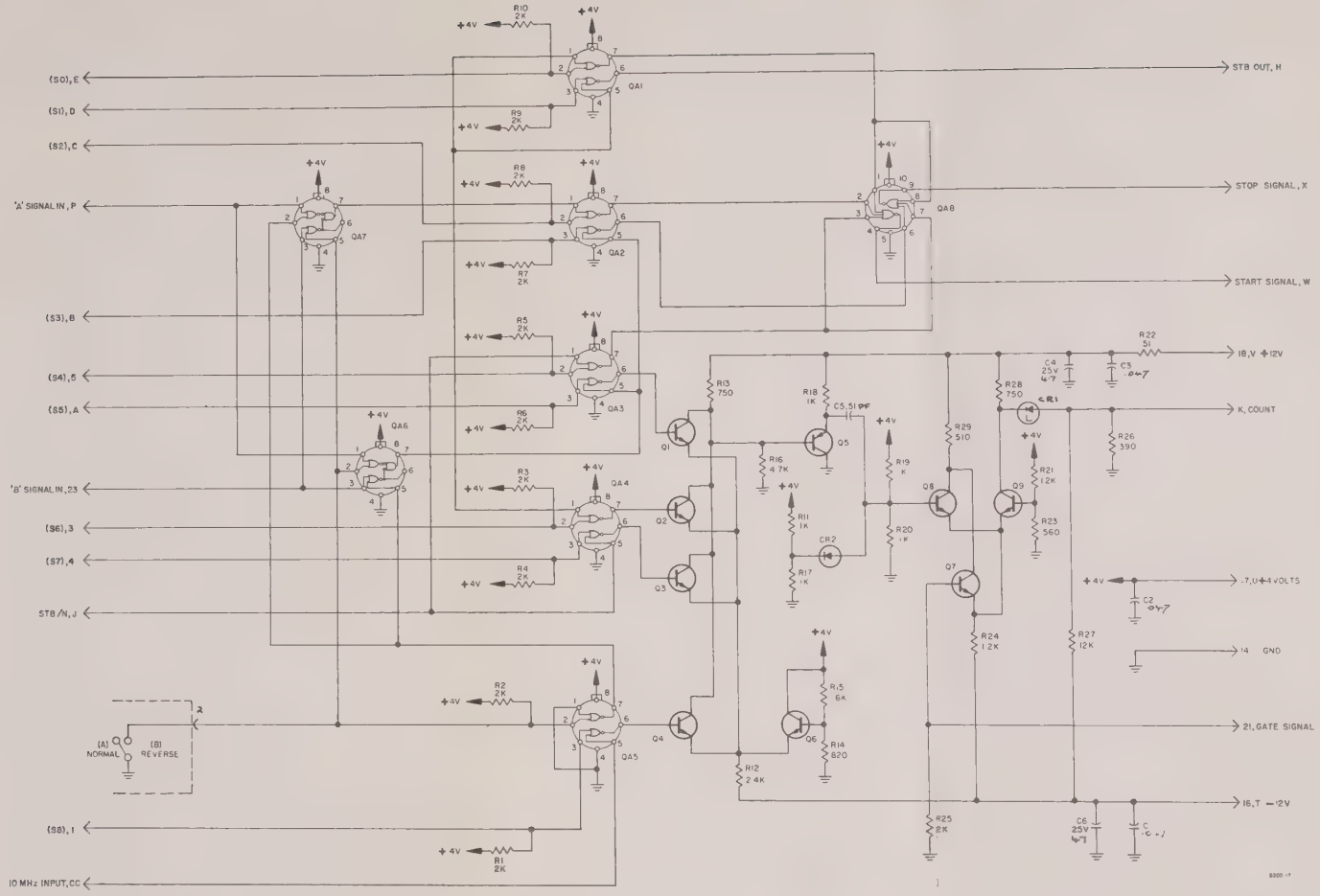


Figure 5-29. Component Location, Function Select Logic Assembly A10



Capacitance values are in microfarads, unless otherwise specified.

Resistance values are in ohms.
K = 1000, M = 1,000,000.

Figure 5-30. Schematic, Function Select Logic Assembly A10

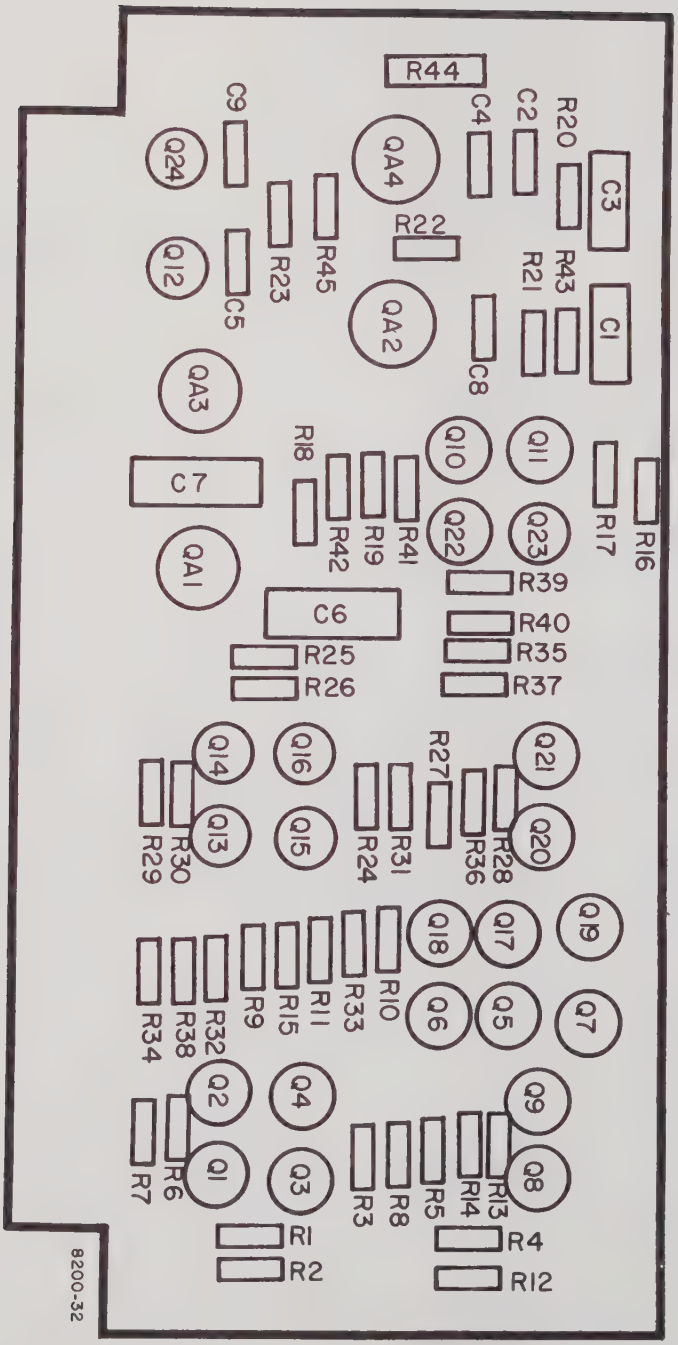
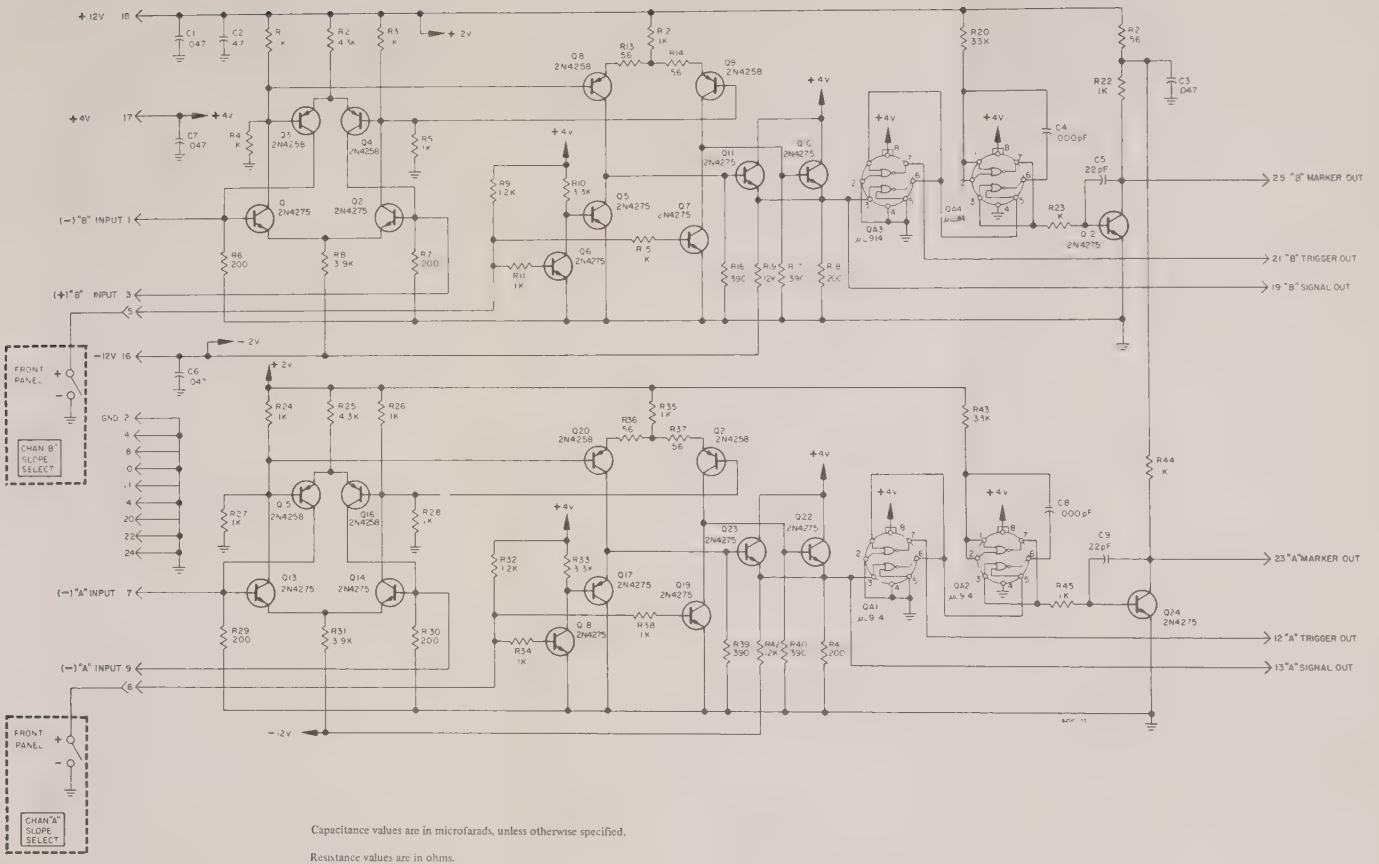


Figure 5-31. Component Location, Dual Input Trigger and Marker Amplifier A11



Capacitance values are in microfarads, unless otherwise specified.

Resistance values are in ohms.
K = 1000, M = 1,000,000.

Figure 5-32. Schematic, Dual Input Trigger and Marker Amplifier Assembly A11

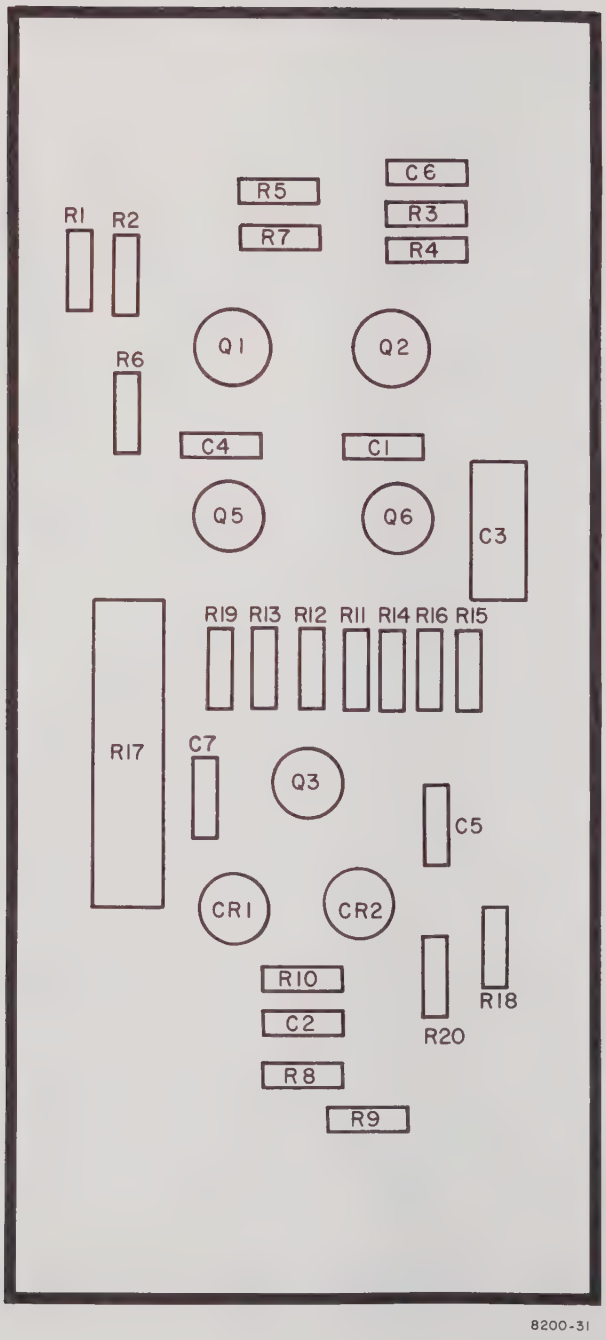
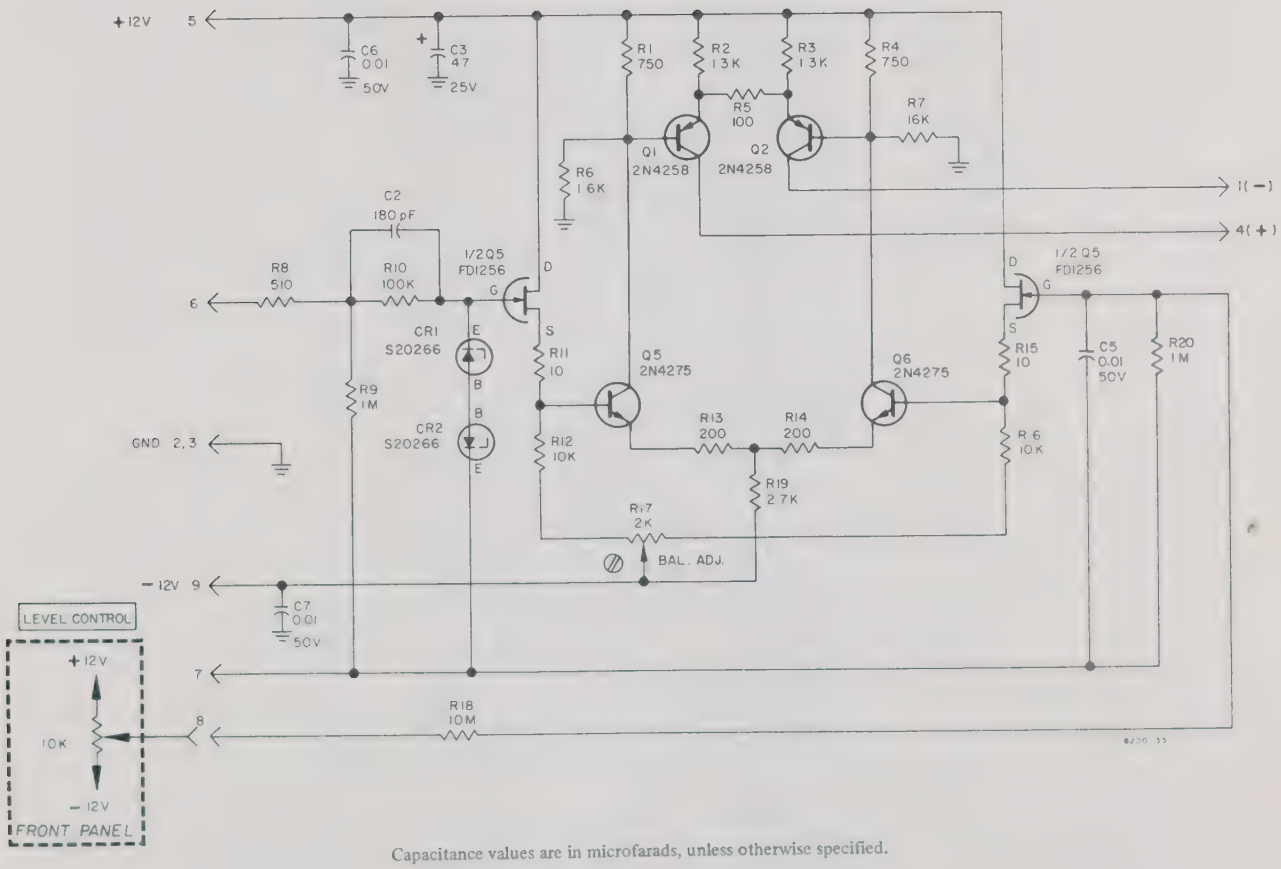


Figure 5-33. Component Location, Input Amplifier Assembly A14, A15



Capacitance values are in microfarads, unless otherwise specified.

Resistance values are in ohms.
K = 1000, M = 1,000,000.

Figure 5-34. Schematic, Input Amplifier Assembly A14, A15

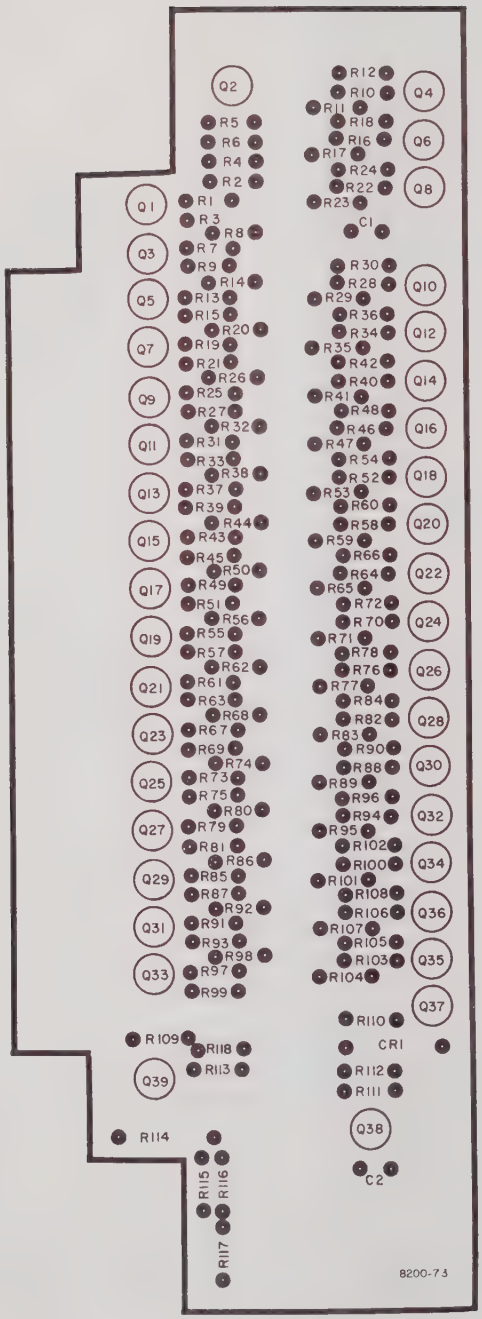


Figure 5-35. Component Location, BCD Inverter Assembly A4—Positive True Logic (Part of Option 01)

Output Output	Code (BCD)	J3 Pin Designation	Remarks
1st Decade (Most Significant Digit)	1 2 4 8	13 14 48 50	
2nd Decade	1 2 4 8	11 12 36 37	
3rd Decade	1 2 4 8	9 10 34 35	
4th Decade	1 2 4 8	7 8 32 33	
5th Decade	1 2 4 8	5 6 30 31	
6th Decade	1 2 4 8	3 4 28 29	
7th Decade (Least Significant Digit)	1 2 4 8	1 2 26 27	
Decimal Point	1 2 4 8	17 18 45 43	
Measurement Units	1 2 4 8	15 16 40 41	
+INHIBIT		22	Stops data from printer. Inhibits decade counters from receiving additional pulses.
+PRINT COMMAND		23	Signals outside printer to print data. Ground.
REF		24	Negative voltage reference. Greater than −5 V.
+REF		25	Positive voltage reference. Greater than +5 V.
GND		1	Ground.

Digit Decoding

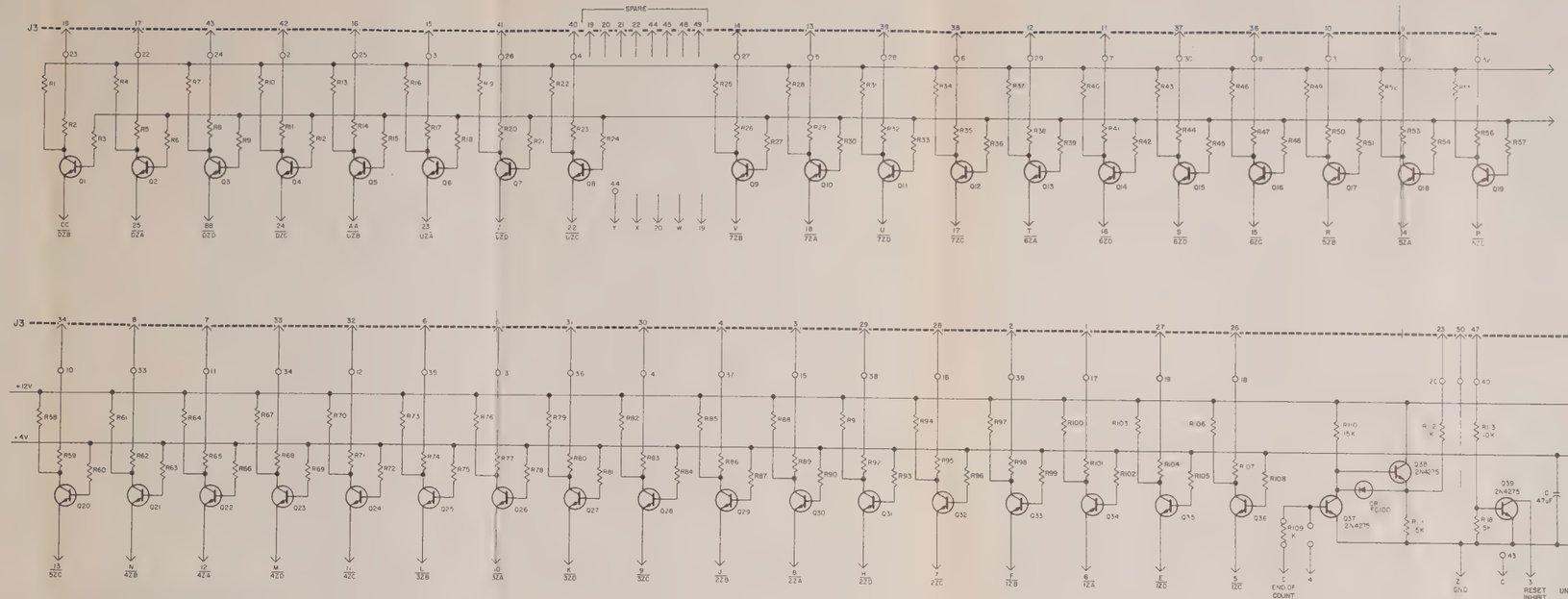
Digit	Print Out	Binary Code 1	2	4	8
0	0	0	0	0	0
1	1	1	0	0	0
2	2	0	1	0	0
3	3	1	1	0	0
4	4	0	0	1	0
5	5	1	0	1	0
6	6	0	1	1	0
7	7	1	1	1	0
8	8	0	0	0	1
9	9	1	0	0	1

Decimal Point Decoding

Decimal Point	Print Out	Binary Code 1	2	4	8
0	0	0	0	0	0
1	1	1	0	0	0
2	2	0	1	0	0
3	3	1	1	0	0
4	4	0	0	1	0
5	5	1	0	1	0
6	6	0	1	1	0
7	7	1	1	1	0

Unit Decoding

Unit	Print Out	Binary Code 1	2	4	8
	0	0	0	0	0
SEC	1	1	0	0	0
MSEC	2	0	1	0	0
μSEC	3	1	1	0	0
nSEC	4	0	0	1	0
PSEC	5	1	0	1	0
	6	0	1	1	0
KHZ	7	1	1	1	0
HZ	8	0	0	0	1
MHZ	9	1	0	0	1
*		0	1	0	1



Capacitance values are in microfarads, unless otherwise specified.

Resistance values are in ohms.
K = 1000, M = 1,000,000.

(Part of Option 01)

Figure 5-36. Schematic, BCD Inverter Assembly A4—Positive True Logic

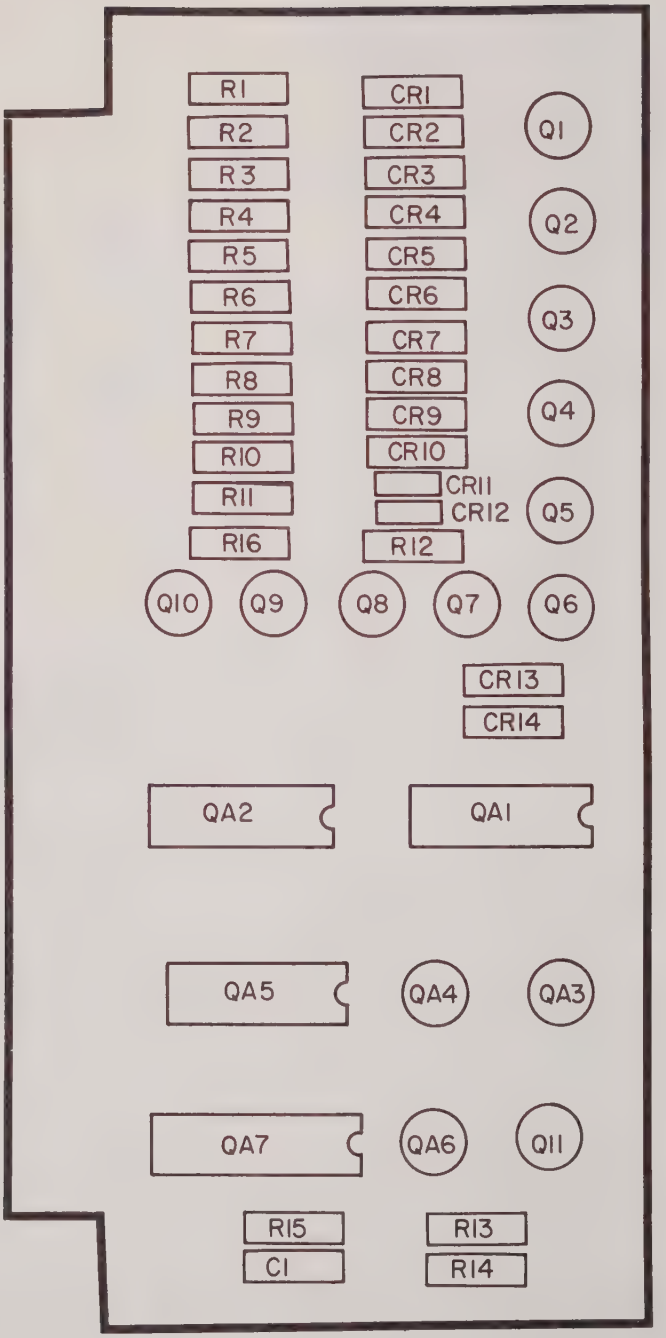
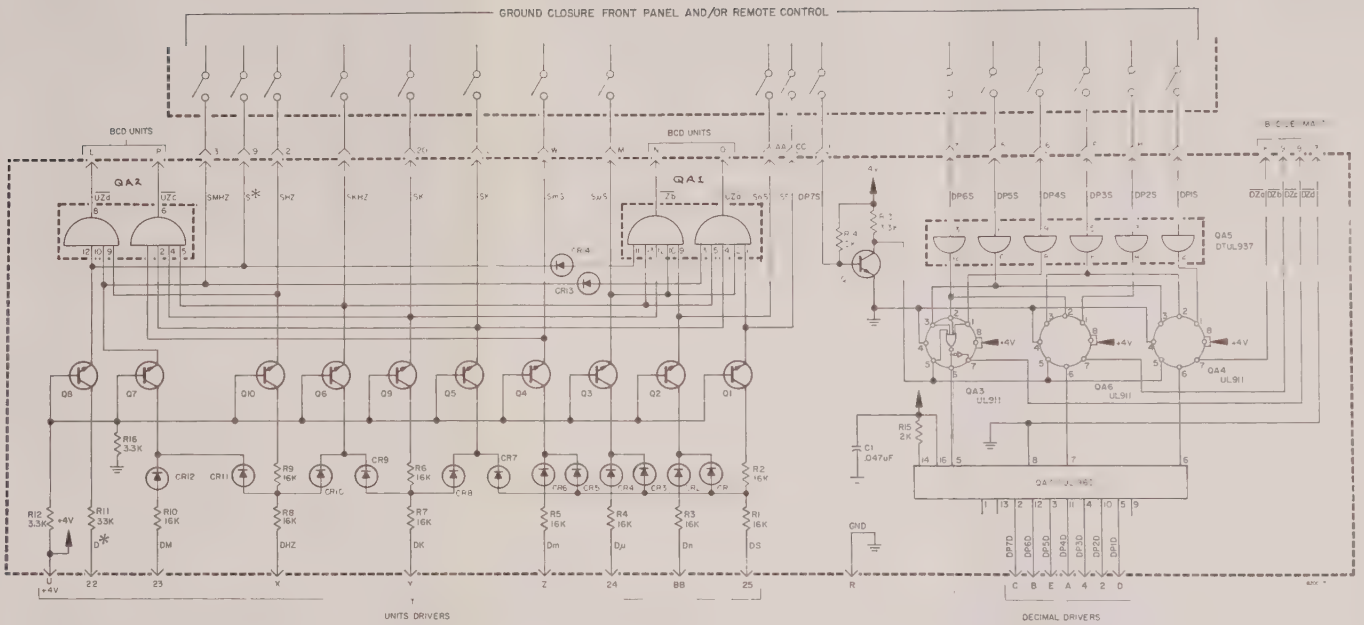


Figure 5-37. Component Location, Units and Decimal Converter Assembly A6
(Part of Option 01 and Option 02)



Capacitance values are in microfarads, unless otherwise specified.

Resistance values are in ohms.
K = 1000, M = 1,000,000.

(Part of Option 01 and Option 02)

Figure 5-38. Schematic, Units and Decimal Converter Assembly A6

Section VI
Replacement Parts

6-1. GENERAL

6-2. Tables 6-1 through 6-15 contain information for ordering replacement parts listing: circuit reference, description manufacturer, and Fairchild Instrumentation part number.

6-3. ORDERING INFORMATION

6-4. To order a replacement part, address order to an authorized Fairchild Instrumentation sales representative or to: 475 Ellis Street, Mountain View, California, 94040.

6-5. Specify the following for each part:

a. Model and serial number of instrument.

b. Fairchild Instrumentation part number.

c. Circuit reference designation, assembly number, or complete description.

6-6. To order a part not listed in tables 6-1 through 6-15, provide a complete description of the part, including function and location.

ABBREVIATIONS

AB	Allen-Bradley Co.
ACDC	ACDC Electronics, Inc.
Alco	Alco Electronics Products, Inc.
Amperex	Amperex Electronics Corp.
Amphenol	Amphenol-Borg Electronics
Belden	Belden Mfg. Co.
Bliley	Bliley Electric Co.
Cinch	Cinch Mfg. Co.
Continental-Wirt	Continental-Wirt Electronics Corp.
Corning	Corning Electronic Products Div.
CTS	Chicago Telephone Supply
Dale	Dale Electronics
Delevan	Delevan Electronics Corp.
Elmenco	The Electro Motive Mfg. Co.
Elpac	Elpac, Inc.
Erie	Erie Resistor Corp.
FI	Fairchild Instrumentation
FSC	Fairchild Semiconductor
Gremar	Gremar Mfg. Co.
H. H. Smith	Herman H. Smith, Inc.
IRC	International Resistance Co.
Kemet	Union Carbide Corp.
Littelfuse	Littelfuse Corp.
MKL	Siemens Co.
Motorola	Motorola Semiconductor Products
Muter	Muter Co.
National Electronics	National Electronics, Inc.
Raytheon	Raytheon Components Div.
RCA	Radio Corp. of America
Rotran	Rotran Mfg. Co.
Sprague	Sprague Electric Co.
TEC	TEC Magnetics
Useco	Useco Div.
Viking	Viking Industries, Inc.

Table 6-1. Main Frame Parts List

Circuit Ref.	Description	Manufacturer	Number
A1	Assembly, 7-Digit Mother Board	FI	92000108
A2	Assembly, Logic Mother Board	FI	92000111
A3	Assembly, 7-Digit Decade	FI	92000109
A4	Assembly, Inverter	FI	92000100
A5	Assembly, Rectifier and Regulator	FI	92000101
A6	Assembly, Diode Matrix	FI	92000102
A7	Assembly, 10 MHz Multiplier	FI	92000107
A8	Assembly, Time Ball	FI	92000105
A9	Assembly, Gate and Display Logic	FI	92000103
A10	Assembly, Function Select Logic	FI	92000104
A11	Assembly, Dual Input Trigger and Marker	FI	92000112
A12	Not assigned		
A13	Not assigned		
A14	Assembly, 12 MHz Input Amplifier	FI	92000113
A15	Same as A14		
A16	Assembly, Oscillator 1 MHz	Bliley	89019881
C1	Capacitor, 20 μF, 350 V	Sprague	03287570
C2	Capacitor, 2000 μF, 25 V	Sprague	03287060
C3	Capacitor, 1100 μF, 25 V	Sprague	03287050
C4	Capacitor, 27000 μF, 10 V	Sprague	03287090
C5	Capacitor, 350 μF, 60 V	Sprague	03287590
DS1	Lamp, Neon	TEC	12013820
DS2	Same as DS1		
F1	Fuse, 1 A, 125 V, S.B.	Littelfuse	11000960
F2	Fuse, ¼ A, 125 V, S.B.	Littelfuse	11001070
J1	Not listed		
J2	Not listed		
J3	Not listed		
J4	Plug, Button Hole	FI	64020261
J5	Same as J4		
J6	Connector, BNC, UG 1094/U		09057610
J7	Same as J6		
J8	Same as J6		
J9	Same as J6		
J10	Filter, AC Line	Sprague	21103180
J11	Connector, BNC	Gremar	09062780
J12	Same as J11		
J13	Jack, test, Black	H.H. Smith	09065870
J14	Same as J13		
	Connector, 25 x 2 Pins	Cinch	09062790

Table 6-1. Main Frame Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
Q1	Transistor, 2N4299	RCA	26014540
Q2	Transistor, 40250	RCA	26014480
Q3	Same as Q2		
Q4	Transistor, SE3030	FSC	26003521
Q5	Transistor, 2N3054	FSC	26014350
R1	Resistor, 1.2 Ω ±5%, 2 W	IRC Type BWH	02402960
R2	Resistor, 2.4 Ω ±5%, 2 W	IRC Type BWH	02402970
R3	Resistor, 0.24 Ω ±5%, 2 W	IRC Type BWH	02394000
R4	Same as R1		
S1	Switch, Function	CTS	05019171
S2	Switch, Time Base	CTS	05019141
S3	Switch, Assembly, Wired		92000155
S4	Same as S3		
S5	Switch, Push Button SPDT	Alco	05036190
S6	Switch, Sliding, Special	Continental-Wirt	05035520
S7	Switch, Push Button DPDT	Alco	05036170
S8	Same as S6		
S9	Switch, COM-SEP-TEST		05019181
S10	Same as S6		
S11	Switch, Sliding	Continental-Wirt	05035520
S12	Same as S11		
S13	Switch, Slide DPDT	Muter	05033390
S14	Same as S11		
T1	Transformer, Power	ACDC	20017181
T2	Transformer, Oven	ACDC	20017191
XF1	Socket, Fuse		11009210
XF2	Same as XF1		
	Miscellaneous		
	Fan, Sprite 3/8 SQ	Rotron	81006110
	Filter, Fan		81005621
	Filter, Display		48006641
	Power Supply Chassis		31036381
	Switch Knob, Skirted, Black	Raytheon	45011010
	Switch Knob, Outer, Red	Raytheon	45011030
	Switch Knob, Black	Raytheon	45011350
	Handle, Strap	FI	64018621
	Shield, Readout Tubes	FI	42025591
	Cover, Top	FI	33042541

Table 6-1. Main Frame Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
	Cover, Bottom	FI	33042601
	Feet, Instrument	FI	35071681
	Bumper, Rubber, Insert		38023680
	Support, Tilt		35071961
	Cord, Line, 7½ ft.	Belden	50303270

Table 6-2. Switch Assembly, S3 and S4, Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, 0.1 μF ±20%, 600 V	Elpac	03285090
C2	Capacitor, 15 pF ±5%, 500 V	Elmenco	03175080
C3	Capacitor, 5 pF ±5%, 500 V	Erie	03287640
C4	Capacitor, 33 pF ±5%, 500 V	Elmenco	03175150
C5	Capacitor, 18 pF ±5%, 500 V	Elmenco	03175090
C6	Capacitor, 2 pF ±5%, 500 V	Erie	03287680
C7	Capacitor, 270 pF ±5%, 500 V	Elmenco	03281430
R1	Resistor, 909 k ±1%, ½ W	Dale	02380270
R2	Resistor, 110 k ±1%, 1/8 W	Dale	02374920
R3	Resistor, 1 M ±1%, ½ W	Dale	02381310
R4	Resistor, 10 k ±1%, 1/8 W	Dale	02373420
S3	Switch, special		05019161
S4	Same as S3		

Table 6-3. 7-Digit Mother Board A1 Parts List

Circuit Ref.	Description	Manufacturer	Number
QA1	Micrologic Element, CμL960	FSC	26012430
QA2	Same as QA1		
QA3	Same as QA1		
QA4	Same as QA1		
QA5	Same as QA1		
QA6	Same as QA1		
QA7	Same as QA1		
R1	Resistor, fixed, 27 k ±5%, ½ W	AB	02030820
R2	Same as R1		
R3	Same as R1		
R4	Same as R1		
R5	Same as R1		
R6	Same as R1		
R7	Same as R1		
R8	Resistor, fixed, 16 k ±5%, ¼ W	Amperex	02040771
R9	Resistor, fixed, 240 k ±5%, ½ W	Amperex	02393481
R10	Same as R9		
XA3	Connector, 72 pin (36x2) Bush	Viking	09062850
XA4	Connector, 50 pin (25x2) Bush	Cinch	09064300
XV1	Socket, Tube, Readout	National Electronics	34011530
XV2	Same as XV1		
XV3	Same as XV1		
XV4	Same as XV1		
XV5	Same as XV1		
XV6	Same as XV1		
XV7	Same as XV1		
XV8	Same as XV1		
	Miscellaneous		
	Spec. Post Terminal Points	Amp Inc.	51019541
V1	Tube, Numeral Readout	National Electronics	25015490
V2	Same as V1		
V3	Same as V1		
V4	Same as V1		
V5	Same as V1		
V6	Same as V1		
V7	Same as V1		
V8	Tube, Enunciator Readout	National Electronics	25015500

Table 6-4. Logic Mother Board A2 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 0.047 μF ±10%, 250 V	Amperex	03281080
R1	Resistor, fixed, 470 Ω ±5%, ¼ W	Amperex	02040401
R2	Not assigned		
R3	Not assigned		
R4	Resistor, fixed, 2 k Ω ±5%, ¼ W	Amperex	02040551
XA7	Connector, 25x1 Bush	Cinch	09064310
XA8	Same as XA7		
XA9	Same as XA7		
XA10	Connector, 25x2 Bush	Cinch	09064300
XA11	Same as XA7		
	Miscellaneous		
	Special Post Terminal Points	Amp Inc.	51019541
	Key, Polarizing	Cinch	09065840

Table 6-5. 7-Digit Decade Counter Assembly A3 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 360 pF ±5%, 500 V	Elmenco	03281460
C2	Capacitor, fixed, 0.047 μF ±10%, 250 V	Amperex	03281080
C3	Capacitor, fixed, 4.7 μF ±20%, 25 V	Kemet	03287470
Q1	Transistor, 2N4275	FSC	26013140
Q2	Transistor, 820364	FSC	26004021
QA1	Micrologic Element, μL926 (selected)	FSC	26004031
QA2	Micrologic Element, μL926	FSC	26011940
QA3	Same as QA2		
QA4	Same as QA2		
QA5	Micrologic Element, μL914	FSC	26010980
QA6	Micrologic Element, CμL959	FSC	26012420
QA7	Micrloogic Element, CμL958	FSC	26012410
QA8	Same as QA6		
QA9	Same a s QA7		
QA10	Same as QA6		
QA11	Same as QA7		
QA12	Same as QA6		
QA13	Same as QA7		
QA14	Same as QA6		
QA15	Same as QA7		
QA16	Same as QA6		
QA17	Same as QA7		
QA18	Same as QA6		
QA19	Same as QA7		
QA20	Micrologic Element, MWμL910	FSC	26011160
QA21	Same as QA20		
R1	Resistor, fixed, 470 Ω ±5%, ¼ W	Amperex	02040401
R2	Resistor, fixed, 47 k Ω ±5%, ¼ W	Amperex	02040881
R3	Resistor, fixed, 1 k Ω ±5%, ¼ W	Amperex	02040481

Table 6-6. BCD Inverter Assembly A4 Parts List

Circuit Ref.	Description	Manufacturer	Number
	NEGATIVE TRUE LOGIC		
C1	Capacitor, fixed, 4.7 μF ±20%, 25 V	Kemet	03287470
CR1	Diode, FD100	FSC	26006930
Q1	Transistor, 2N4275	FSC	26013140
Q2	Same as Q1		
Q3	Same as Q1		
Q4	Same as Q1		
Q5	Same as Q1		
Q6	Same as Q1		
Q7	Same as Q1		
Q8	Same as Q1		
Q9	Same as Q1		
Q10	Same as Q1		
Q11	Same as Q1		
Q12	Same as Q1		
Q13	Same as Q1		
Q14	Same as Q1		
Q15	Same as Q1		
Q16	Same as Q1		
Q17	Same as Q1		
Q18	Same as Q1		
Q19	Same as Q1		
Q20	Same as Q1		
Q21	Same as Q1		
Q22	Same as Q1		
Q23	Same as Q1		
Q24	Same as Q1		
Q25	Same as Q1		
Q26	Same as Q1		
Q27	Same as Q1		
Q28	Same as Q1		
Q29	Same as Q1		
Q30	Same as Q1		
Q31	Same as Q1		
Q32	Same as Q1		
Q33	Same as Q1		
Q34	Same as Q1		
Q35	Same as Q1		

Table 6-6. BCD Inverter Assembly A4 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
Q36	Same as Q1		
Q37	Same as Q1		
Q38	Same as Q1		
Q39	Same as Q1		
Q40	Same as Q1		
R1	Resistor, fixed, 15 kΩ ±10%, 1/8 W	AB	02415750
R2	Resistor, fixed, 10 kΩ ±10%, 1/8 W	AB	02415740
R3	Same as R1		
R4	Same as R2		
R5	Same as R1		
R6	Same as R2		
R7	Same as R1		
R8	Same as R2		
R9	Same as R1		
R10	Same as R2		
R11	Same as R1		
R12	Same as R2		
R13	Same as R1		
R14	Same as R2		
R15	Same as R1		
R16	Same as R2		
R17	Same as R1		
R18	Same as R2		
R19	Same as R1		
R20	Same as R2		
R21	Same as R1		
R22	Same as R2		
R23	Same as R1		
R24	Same as R2		
R25	Same as R1		
R26	Same as R2		
R27	Same as R1		
R28	Same as R2		
R29	Same as R1		
R30	Same as R2		
R31	Same as R1		
R32	Same as R2		
R33	Same as R1		
R34	Same as R2		
R35	Same as R1		

Table 6-6. BCD Inverter Assembly A4 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R36	Same as R2		
R37	Same as R1		
R38	Same as R2		
R39	Same as R1		
R40	Same as R2		
R41	Same as R1		
R42	Same as R2		
R43	Same as R1		
R44	Same as R2		
R45	Same as R1		
R46	Same as R2		
R47	Same as R1		
R48	Same as R2		
R49	Same as R1		
R50	Same as R2		
R51	Same as R1		
R52	Same as R2		
R53	Same as R1		
R54	Same as R2		
R55	Same as R1		
R56	Same as R2		
R57	Same as R1		
R58	Same as R2		
R59	Same as R1		
R60	Same as R2		
R61	Same as R1		
R62	Same as R2		
R63	Same as R1		
R64	Same as R2		
R65	Same as R1		
R66	Same as R2		
R67	Same as R1		
R68	Same as R2		
R69	Same as R1		
R70	Same as R2		
R71	Same as R1		
R72	Same as R2		
R73	Same as R1		
R74	Resistor, fixed, 1 kΩ ±5%, 1/8 W	AB	02395680
R75	Same as R1		

Table 6-6. BCD Inverter Assembly A4 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R76	Same as R74		
R77	Same as R2		
R78	Same as R74		
R79	Resistor, fixed, 2 kΩ ±5%, 1/8 W	AB	02354140
R80	Resistor, fixed, 3.9 kΩ ±5%, 1/8 W	AB	02395820
R81	Resistor, fixed, 6.2 kΩ ±5%, 1/8 W	AB	02395870
R82	Resistor, fixed, 2 kΩ ±5%, 1/8 W	AB	02395750
	POSITIVE TRUE LOGIC		
C1	Capacitor, fixed, 4.7 μF ±20%, 25 V	Kemet	03287470
C2	Same as C1		
CR1	Diode, FD100	FSC	26006930
Q1	Transistor, 2N4275	FSC	26013140
Q2	Same as Q1		
Q3	Same as Q1		
Q4	Same as Q1		
Q5	Same as Q1		
Q6	Same as Q1		
Q7	Same as Q1		
Q8	Same as Q1		
Q9	Same as Q1		
Q10	Same as Q1		
Q11	Same as Q1		
Q12	Same as Q1		
Q13	Same as Q1		
Q14	Same as Q1		
Q15	Same as Q1		
Q16	Same as Q1		
Q17	Same as Q1		
Q18	Same as Q1		
Q19	Same as Q1		
Q20	Same as Q1		
Q21	Same as Q1		
Q22	Same as Q1		
Q23	Same as Q1		
Q24	Same as Q1		
Q25	Same as Q1		

Table 6-6. BCD Inverter Assembly A4 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
Q26	Same as Q1		
Q27	Same as Q1		
Q28	Same as Q1		
Q29	Same as Q1		
Q30	Same as Q1		
Q31	Same as Q1		
Q32	Same as Q1		
Q33	Same as Q1		
Q34	Same as Q1		
Q35	Same as Q1		
Q36	Same as Q1		
Q37	Same as Q1		
Q38	Same as Q1		
Q39	Same as Q1		
R1	Resistor, fixed, 5 kΩ ±10%, 1/8 W	AB	02415750
R2	Resistor, fixed, 10 kΩ ±10%, 1/8 W	AB	02415740
R3	Same as R2		
R4	Same as R1		
R5	Same as R2		
R6	Same as R2		
R7	Same as R1		
R8	Same as R2		
R9	Same as R2		
R10	Same as R1		
R11	Same as R2		
R12	Same as R2		
R13	Same as R1		
R14	Same as R2		
R15	Same as R2		
R16	Same as R1		
R17	Same as R2		
R18	Same as R2		
R19	Same as R1		
R20	Same as R2		
R21	Same as R2		
R22	Same as R1		
R23	Same as R2		
R24	Same as R2		
R25	Same as R1		

Table 6-6. BCD Inverter Assembly A4 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R26	Same as R2		
R27	Same as R2		
R28	Same as R1		
R29	Same as R2		
R30	Same as R2		
R31	Same as R1		
R32	Same as R2		
R33	Same as R2		
R34	Same as R1		
R35	Same as R2		
R36	Same as R2		
R37	Same as R1		
R38	Same as R2		
R39	Same as R2		
R40	Same as R1		
R41	Same as R2		
R42	Same as R2		
R43	Same as R1		
R44	Same as R2		
R45	Same as R2		
R46	Same as R1		
R47	Same as R2		
R48	Same as R2		
R49	Same as R1		
R50	Same as R2		
R51	Same as R2		
R52	Same as R1		
R53	Same as R2		
R54	Same as R2		
R55	Same as R1		
R56	Same as R2		
R57	Same as R2		
R58	Same as R1		
R59	Same as R2		
R60	Same as R2		
R61	Same as R1		
R62	Same as R2		
R63	Same as R2		
R64	Same as R1		
R65	Same as R2		

Table 6-6. BCD Inverter Assembly A4 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R66	Same as R2		
R67	Same as R1		
R68	Same as R2		
R69	Same as R2		
R70	Same as R1		
R71	Same as R2		
R72	Same as R2		
R73	Same as R1		
R74	Same as R2		
R75	Same as R2		
R76	Same as R1		
R77	Same as R2		
R78	Same as R2		
R79	Same as R1		
R80	Same as R2		
R81	Same as R2		
R82	Same as R1		
R83	Same as R2		
R84	Same as R2		
R85	Same as R1		
R86	Same as R2		
R87	Same as R2		
R88	Same as R1		
R89	Same as R2		
R90	Same as R2		
R91	Same as R1		
R92	Same as R2		
R93	Same as R2		
R94	Same as R1		
R95	Same as R2		
R96	Same as R2		
R97	Same as R1		
R98	Same as R2		
R99	Same as R2		
R100	Same as R1		
R101	Same as R2		
R102	Same as R2		
R103	Same as R1		
R104	Same as R2		
R105	Same as R2		

Table 6-6. BCD Inverter Assembly A4 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R106	Same as R1		
R107	Same as R2		
R108	Same as R2		
R109	Resistor, fixed, 1 kΩ ±5%, 1/8 W	AB	02395680
R110	Same as R1		
R111	Same as R1		
R112	Same as R109		
R113	Same as R2		
R114	Resistor, fixed, 10 Ω ±5%, ¼ W	AB	02354140
R115	Resistor, fixed, 3.9 kΩ ±5%, 1/8 W	AB	02395820
R116	Resistor, fixed, 6.2 kΩ ±5%, 1/8 W	AB	02395870
R117	Resistor, fixed, 2 kΩ ±5%, 1/8 W	AB	02395750

Table 6-7. Rectifier and Regulator Assembly A5 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 0.033 μF ±10%, 400 V	Amperex	03285630
C2	Not listed		
C3	Capacitor, fixed, 0.047 μF ±10%, 250 V	Amperex	03281080
C4	Capacitor, fixed, 100 μF ±10%, 250 V	Sprague	03280300
C5	Same as C3		
C6	Same as C3		
C7	Same as C3		
C8	Capacitor, fixed, 4.7 μF ±20%, 25 V	Kemet	03287470
C9	Same as C3		
C10	Same as C3		
C11	Same as C4		
C12	Same as C3		
C13	Same as C3		
C14	Same as C3		
C15	Same as C8		
C16	Same as C3		
C17	Same as C3		
C18	Same as C3		
C19	Same as C3		
C20	Same as C8		
C21	Same as C3		
C22	Same as C3		
C23	Same as C3		
C24	Same as C3		
CR1	Diode, 1N4004	Motorola	26012680
CR2	Same as CR1		
CR3	Same as CR1		
CR4	Same as CR1		
CR5	Transistor, S20266	FSC	26003501
CR6	Same as CR1		
CR7	Same as CR1		
CR8	Same as CR5		
CR9	Same as CR1		
CR10	Same as CR1		
CR11	Same as CR5		
CR12	Diode, MR1030B	Motorola	26013250
CR13	Same as CR12		
CR14	Same as CR1		
CR15	Same as CR1		
CR16	Same as CR5		

Table 6-7. Rectifier and Regulator Assembly A5 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
Q1	Transistor, 2N1711	FSC	26007450
Q2	Transistor, SE2002	FSC	26012630
Q3	Same as Q2		
Q4	Same as Q1		
Q5	Same as Q2		
Q6	Same as Q2		
Q7	Same as Q2		
Q8	Transistor, 2N3300	FSC	26012940
Q9	Same as Q2		
Q10	Same as Q2		
Q11	Same as Q2		
Q12	Transistor, 2N3107	FSC	26012170
Q13	Same as Q2		
Q14	Same as Q2		
R1	Resistor, fixed, 62 Ω ±5%, ½ W	Amperex	02392621
R2	Resistor, fixed, 200 Ω ±5%, ¼ W	Amperex	02040311
R3	Resistor, variable, 100 Ω	Amphenol	01095380
R4	Resistor, fixed, 100 Ω ±1%, ¼ W	Corning	02404060
R5	Resistor, fixed, 150 kΩ ±5%, ¼ W		02034000
R6	Resistor, fixed, 3.9 kΩ ±5%, ¼ W	Amperex	02040621
R7	Resistor, fixed, 1 kΩ ±5%, ¼ W	Amperex	02040481
R8	Resistor, 47 Ω ±5%, ½ W	Amperex	02392591
R9	Same as R7		
R10	Resistor, fixed, 4.7 kΩ ±5%, ¼ W	Amperex	02040641
R11	Resistor, fixed, 100 Ω ±5%, ¼ W	Amperex	02040241
R12	Resistor, fixed, 1.8 kΩ ±5%, ¼ W	Amperex	02040541
R13	Resistor, variable, 1 kΩ	Amphenol	01095400
R14	Resistor, fixed, 910 Ω ±5%, ¼ W	Amperex	02040471
R15	Resistor, fixed, 1.5 kΩ ±5%, ¼ W	Amperex	02040521
R16	Same as R6		
R17	Same as R8		
R18	Same as R7		
R19	Same as R7		
R20	Same as R10		
R21	Same as R11		
R22	Same as R12		
R23	Same as R13		
R24	Same as R14		
R25	Same as R15		
R26	Same as R6		
R27	Same as R10		

Table 6-7. Rectifier and Regulator Assembly A5 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R28	Resistor, fixed, 470 Ω ±5%, ¼ W	Amperex	02040401
R29	Resistor, fixed, 68 kΩ ±5%, ¼ W	Amperex	02040681
R30	Resistor, fixed, 1.7 kΩ ±5%, ¼ W	Amperex	02040581
R31	Same as R11		
R32	Same as R28		
R33	Same as R10		
R34	Resistor, fixed, 1 kΩ ±1%, ¼ W	Corning	02405020
R35	Resistor, fixed, 3.01 kΩ ±1%, ¼ W	Corning	02405480
R36	Resistor, fixed, 10 kΩ ±5%, ¼ W	Amperex	02040721
R37	Resistor, fixed, 100 Ω ±5%, ½ W	Amperex	02392671
R38	Resistor, fixed, 3.3 kΩ ±5%, ½ W	Amperex	02393031
R39	Resistor, fixed 15 kΩ ±5%, ¼ W	Amperex	02040761
R40	Same as R11		
R41	Resistor, fixed, 5.6 kΩ ±5%, ¼ W	Amperex	02040661
R42	Resistor, variable, 2 kΩ	Amphenol	01095370
R43	Same as R6		
R44	Same as R15		
TP1	Terminal	Useco	51023950
TP2	Same as TP1		
TP3	Same as TP1		
TP4	Same as TP1		
TP5	Same as TP1		

Table 6-8. Unit and Decimal Conversion A6 Parts List
(Part of Option 01 and Option 02)

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, .04 μF ±10%, 250 V	Amperex	03281080
CR1	Diode, FD200	FSC	26011850
CR2	Same as CR1		
CR3	Same as CR1		
CR4	Same as CR1		
CR5	Same as CR1		
CR6	Same as CR1		
CR7	Same as CR1		
CR8	Same as CR1		
CR9	Same as CR1		
CR10	Same as CR1		
CR11	Same as CR1		
CR12	Same as CR1		
CR13	Same as CR1		
CR14	Same as CR1		
Q1	Transistor, S20364	FSC	26004021
Q2	Same as Q1		
Q3	Same as Q1		
Q4	Same as Q1		
Q5	Same as Q1		
Q6	Same as Q1		
Q7	Same as Q1		
Q8	Same as Q1		
Q9	Same as Q1		
Q10	Same as Q1		
Q11	Same as Q1		
QA1	Micrologic Element, DTμL961	FSC	26013230
QA2	Same as QA1		
QA3	Micrologic Element, MWμL911	FSC	26012490
QA4	Same as QA3		
QA5	Micrologic Element, DTμL937	FSC	26013830
QA6	Same as QA3		
QA7	Micrologic Element, CμL960	FSC	26012430
R1	Resistor, fixed, 16 kΩ ±5%, ¼ W	Amperex	02040771
R2	Same as R1		
R3	Same as R1		
R4	Same as R1		
R5	Same as R1		

Table 6-8. Unit and Decimal Conversion A6 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R6	Same as R1		
R7	Same as R1		
R8	Same as R1		
R9	Same as R1		
R10	Same as R1		
R11	Resistor, fixed, 33 kΩ ±5%, ¼ W	Amperex	02040841
R12	Resistor fixed, 3.3 kΩ ±5%, ¼ W	Amperex	02040601
R13	Same as R12		
R14	Resistor, fixed, 2 kΩ ±5%, ¼ W	Amperex	02040551
R15	Same as R14		
R16	Same as R12		

Table 6-9. 10 MHz Multiplier Assembly A7 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 0.047 μF ±10%, 250 V	Amperex	03281080
C2	Capacitor, fixed, 4.7 μF ±20%, 25 V	Kemet	03287470
C3	Same as C1		
C4	Same as C1		
C5	Same as C2		
C6	Capacitor, fixed, 39 pF ±5%, 500 V	Elmenco	03175170
C7	Capacitor, fixed, 0.01 μF ±10%, 250 V	Amperex	03281000
C8	Capacitor, fixed, 100 pF ±5%, 500 V	Elmenco	03281320
C9	Capacitor, fixed, 680 pF ±5%, 300 V	Elmenco	03281540
C10	Capacitor, fixed, 68 pF ±5%, 500 V	Elmenco	03175240
L1	Coil, 3 μH		21022051
L2	Coil, 3.3 μH	Delevan	21103000
Q1	Transistor, 2N4275	FSC	26013140
Q2	Same as Q1		
Q3	Transistor, 2N4258	FSC	26014011
Q4	Same as Q3		
QA1	Micrologic Element, μL914	FSC	26010980
R1	Resistor, fixed, 470 Ω ±5%, ¼ W	Amperex	02040401
R2	Resistor, fixed 9.1 kΩ ±5%, ¼ W	Amperex	02040711
R3	Resistor, fixed, 820 Ω ±5%, ¼ W	Amperex	02040461
R4	Resistor, fixed, 100 Ω ±5%, ¼ W	Amperex	02040241
R5	Resistor, fixed, 220 Ω ±5%, ¼ W	Amperex	02040321
R6	Resistor, fixed, 1.8 kΩ ±5%, ¼ W	Amperex	02040541
R7	Resistor, fixed, 750 Ω ±5%, ¼ W	Amperex	02040451
R8	Resistor, fixed, 2 kΩ ±5%, ¼ W	Amperex	02040551
R9	Resistor, fixed, 4.7 kΩ ±5%, ¼ W	Amperex	02040641
R10	Resistor, fixed, 120 Ω ±5%, ¼ W	Amperex	02040261
R11	Resistor, fixed, 1 kΩ ±5%, ¼ W	Amperex	02040481
R12	Same as R9		
R13	Same as R10		
R14	Same as R9		
R15	Same as R8		
R16	Resistor, fixed, 24 kΩ ±5%, ¼ W	Amperex	02040811
R17	Resistor, fixed, 390 Ω ±5%, ¼ W	Amperex	02040401
R18	Same as R16		
R19	Same as R17		

Table 6-10. Time Base Assembly A8 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 0.1 μF ±10%, 250 V	Amperex	03281120
C2	Same as C1		
C3	Same as C1		
C4	Capacitor, fixed, 0.047 μF ±10%, 250 V	Amperex	03281080
C5	Capacitor, fixed, 0.01 μF ±20%, 50 V	Sprague	03281960
C6	Capacitor, fixed, 4.7 μF ±20%, 25 V	Kemet	03287470
Q1	Transistor, SE2002	FSC	26012630
QA1	Micrologic Element, MWμL921	FSC	26012460
QA2	Same as QA1		
QA3	Same as QA1		
QA4	Same as QA1		
QA5	Same as QA1		
QA6	Same as QA1		
QA7	Same as QA1		
QA8	Micrologic Element, CμL958	FSC	26012490
QA9	Same as QA8		
QA10	Same as QA8		
QA11	Same as QA8		
QA12	Same as QA8		
QA13	Same as QA8		
QA14	Same as QA8		
QA15	Micrologic Element, MWμL910	FSC	26012900
QA16	Same as QA15		
QA17	Same as QA15		
QA18	Same as QA15		
QA19	Same as QA15		
QA20	Micrologic Element, MWμL911	FSC	26012490
QA21	Same as QA20		
QA22	Same as QA15		
QA23	Micrologic Element, μL914	FSC	26010980
QA24	Micrologic Element, μL900	FSC	26012900
R1	Resistor, fixed, 4.7 kΩ ±5%, ¼ W	Amperex	02040641
R2	Same as R1		
R3	Resistor, fixed, 470 Ω ±5%, ¼ W	Amperex	02040401
R4	Same as R1		
R5	Same as R3		
R6	Same as R1		
R7	Same as R3		
R8	Same as R1		
R9	Same as R3		

Table 6-10. Time Base Assembly A8 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R10	Same as R1		
R11	Same as R3		
R12	Same as R1		
R13	Same as R3		
R14	Same as R1		
R15	Same as R3		
R16	Resistor, fixed, 1 kΩ ±5%, ¼ W	Amperex	02040481
R17	Resistor, fixed, 7.5 kΩ ±5%, ¼ W	Amperex	02040691
R18	Resistor, fixed, 390 Ω ±5%, ¼ W	Amperex	02040381
R19	Resistor, fixed, 6.8 kΩ ±5%, ¼ W	Amperex	02040681
R20	Same as R1		
R21	Resistor, fixed, 1 kΩ ±5%, ½ W	Amperex	02392911
R22	Resistor, fixed, 1.5 kΩ ±5%, ¼ W	Amperex	02040521
R23	Same as R22		
R24	Same as R18		
R25	Resistor, fixed, 3.9 kΩ ±5%, ¼ W	Amperex	02040621
R26	Same as R18		
R27	Same as R19		
R28	Resistor, fixed, 100 Ω ±5%, ¼ W	Amperex	02040241

Table 6-11. Gate and Display Logic Assembly A9 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 39 pF ±5%, 500 V	Elmenco	03175170
C2	Same as C1		
C3	Capacitor, fixed, 1000 pF ±5%, 100 V	Elmenco	03176750
C4	Capacitor, fixed, 6.8 μF, 63 V	MKL	03286290
C5	Capacitor, fixed, 1.0 μF ±10%, 35 V	Sprague	03282660
C6	Capacitor, fixed, 0.047 μF ±10%, 250 V	Amperex	03281080
C7	Same as C6		
C8	Capacitor, fixed, 0.01 μF ±10%, 250 V	Amperex	03281000
C9	Capacitor, fixed, 470 pF ±5%, 500 V	Elmenco	03281490
C10	Capacitor, fixed, 4.7 ΩF ±20%, 25 V	Kemet	03287470
C11	Capacitor, fixed, 8.2 μF ±10%, 15 V	Kemet	03287140
C12	Same as C10		
C13	Same as C10		
C14	Same as C10		
CR1	Diode, FD100	FSC	26006930
CR2	Same as CR1		
CR3	Same as CR1		
CR4	Diode, FD300	FSC	26012320
Q1	Transistor, S20364	FSC	26004021
Q2	Transistor, 2N4275	FSC	26013140
Q3	Transistor, 2N4852	FSC	26013840
Q4	Same as Q2		
QA1	Micrologic Element, μL915	FSC	26012070
QA2	Same as QA1		
QA3	Micrologic Element, μL914	FSC	26010980
QA4	Same as QA3		
QA5	Micrologic Element, MWμL910	FSC	26011160
QA6	Micrologic Element, μL900	FSC	26012900
QA7	Micrologic Element, μL904	FSC	26011950
QA8	Same as QA3		
QA9	Same as QA5		
QA10	Same as QA3		
QA11	Same as QA6		
QA12	Same as QA6		
QA13	Same as QA3		
R1	Resistor, fixed, 2.7 kΩ ±5%, ¼ W	Amperex	02040581
R2	Same as R1		
R3	Resistor, fixed, 100 Ω ±5%, ¼ W	Amperex	02040241
R4	Resistor, fixed, 33 k Ω ±5%, ¼ W	Amperex	02040841
R5	Same as R3		

Table 6-11. Gate and Display Logic Assembly A9 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R6	Resistor, fixed, 470 Ω ±5%, ¼ W	Amperex	02040401
R7	Same as R6		
R8	Resistor, fixed, 1.5 kΩ ±5%, ¼ W	Amperex	02040521
R9	Resistor, fixed, 300 Ω ±5%, ¼ W	Amperex	02040351
R10	Resistor, fixed, 2 kΩ ±5%, ¼ W	Amperex	02040551
R11	Resistor, fixed, 1 kΩ ±5%, ¼ W	Amperex	02040481
R12	Resistor, fixed, 2 kΩ ±5%, ½ W	Amperex	02392981
R13	Resistor, fixed, 68 kΩ ±5%, ¼ W	Amperex	02040921
R14	Resistor, fixed, 10 kΩ ±5%, ¼ W	Amperex	02040721
R15	Same as R16		
R16	Resistor, fixed, 15 kΩ ±5%, ¼ W	Amperex	02040761
R17	Resistor, fixed, 5.6 kΩ ±5%, ¼ W	Amperex	02040661
R18	Resistor, fixed, 47 kΩ ±5%, ¼ W	Amperex	02040881
R19	Resistor, fixed, 3.9 kΩ ±5%, ¼ W	Amperex	02040621
R20	Resistor, fixed, 8.2 kΩ ±5%, ¼ W	Amperex	02040701
R21	Same as R19		
R22	Same as R6		
R23	Same as R3		

Table 6-12. Function Select Logic Assembly A10 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 0.047 μF ±10%, 250 V	Amperex	03281080
C2	Same as C1		
C3	Same as C1		
C4	Capacitor, fixed, 4.7 μF ±20%, 25 V	Kemet	03287470
C5	Capacitor, fixed, 51 pF ±5%, 500 V	Elmenco	03175210
C6	Same as C4		
CR1	Transistor, S20266	FSC	26003501
CR2	Diode, FD100	FSC	26006930
Q1	Transistor, 2N4275	FSC	26013140
Q2	Same as Q1		
Q3	Same as Q1		
Q4	Same as Q1		
Q5	Transistor, 2N4258	FSC	26014011
Q6	Same as Q1		
Q7	Same as Q1		
Q8	Same as Q1		
Q9	Same as Q1		
QA1	Micrologic Element, μL914	FSC	26010980
QA2	Same as QA1		
QA3	Same as QA1		
QA4	Same as QA1		
QA5	Same as QA1		
QA6	Micrologic Element, μL904	FSC	26011950
QA7	Same as QA6		
QA8	Micrologic Element, μL915	FSC	26012070
R1	Resistor, fixed, 2 kΩ ±5%, ¼ W	FSC	02040551
R2	Same as R1		
R3	Same as R1		
R4	Same as R1		
R5	Same as R1		
R6	Same as R1		
R7	Same as R1		
R8	Same as R1		
R9	Same as R1		
R10	Same as R1		
R11	Resistor, fixed, 1 kΩ ±5%, ¼ W	Amperex	02040481
R12	Resistor, fixed, 2.4 kΩ ±5%, ¼ W	Amperex	02040571
R13	Resistor, fixed, 750 Ω ±5%, ¼ W	Amperex	02040451
R14	Resistor, fixed, 820 Ω ±5%, ¼ W	Amperex	02040461
R15	Resistor, fixed, 1.6 kΩ ±5%, ¼ W	Amperex	02040531

Table 6-12. Function Select Logic Assembly A10 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R16	Resistor, fixed, 4.7 kΩ ±5%, ¼ W	Amperex	02040641
R17	Same as R11		
R18	Same as R11		
R19	Same as R11		
R20	Same as R11		
R21	Resistor, fixed, 1.2 kΩ ±5%, ¼ W	Amperex	02040501
R22	Resistor, fixed, 51 Ω ±5%, ¼ W	Amperex	02040171
R23	Resistor, fixed, 560 Ω ±5%, ¼ W	Amperex	02040421
R24	Resistor, fixed, 1.2 kΩ ±5%, ½ W	Amperex	02329931
R25	Same as R1		
R26	Resistor, fixed, 390 Ω ±5%, ¼ W	Amperex	02040381
R27	Resistor, fixed, 12 kΩ ±5%, ¼ W	Amperex	02040741
R28	Same as R13		
R29	Resistor, fixed, 50 Ω ±5%, ¼ W	Amperex	02040411

Table 6-13. Dual Input Trigger and Marker Generator Assembly A11 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Capacitor, fixed, 0.047 μF ±10%, 250 V	Amperex	03281080
C2	Capacitor, fixed, 4.7 μF ±20%, 25 V	Kemet	03287470
C3	Same as C1		
C4	Capacitor, fixed, 1000 pF ±5%, 100 V	Elmenco	03176750
C5	Capacitor, fixed, 22 pF ±5%, 500 V	Elmenco	03175110
C6	Same as C1		
C7	Same as C1		
C8	Same as C4		
C9	Same as C5		
Q1	Transistor, 2N4275	FSC	26013140
Q2	Same as Q1		
Q3	Transistor, 2N4258	FSC	26014011
Q4	Same as Q3		
Q5	Same as Q1		
Q6	Same as Q1		
Q7	Same as Q1		
Q8	Same as Q3		
Q9	Same as Q3		
Q10	Same as Q1		
Q11	Same as Q1		
Q12	Same as Q1		
Q13	Same as Q1		
Q14	Same as Q1		
Q15	Same as Q3		
Q16	Same as Q3		
Q17	Same as Q1		
Q18	Same as Q1		
Q19	Same as Q1		
Q20	Same as Q3		
Q21	Same as Q3		
Q22	Same as Q1		
Q23	Same as Q1		
Q24	Same as Q1		
QA1	Micrologic Element, μL914	FSC	26010980
QA2	Same as QA1		
QA3	Same as QA1		
QA4	Same as QA1		
R1	Resistor, fixed, 1 kΩ ±5%, ¼ W	Amperex	02040481
R2	Resistor, fixed, 4.3 kΩ ±5%, ¼ W	Amperex	02040631
R3	Same as R1		
R4	Same as R1		

Table 6-13. Dual Input Trigger and Marker Generator Assembly A11 Parts List (Continued)

Circuit Ref.	Description	Manufacturer	Number
R5	Same as R1		
R6	Resistor, fixed, 200 Ω ±5%, ¼ W	Amperex	02040311
R7	Same as R6		
R8	Resistor, fixed, 3.9 kΩ ±5%, ¼ W	Amperex	02040621
R9	Resistor, fixed, 1.2 kΩ ±5%, ¼ W	Amperex	02040501
R10	Resistor, fixed, 3.3 kΩ ±5%, ¼ W	Amperex	02040601
R11	Same as R1		
R12	Same as R1		
R13	Resistor, fixed, 56 Ω ±5%, ¼ W	Amperex	02040181
R14	Same as R13		
R15	Same as R1		
R16	Resistor, fixed, 390 Ω ±5%, ¼ W	Amperex	02040381
R17	Same as R16		
R18	Same as R6		
R19	Resistor, fixed, 12 kΩ ±5%, ¼ W	Amperex	02040741
R20	Resistor, fixed, 33 kΩ ±5%, ¼ W	Amperex	02040841
R21	Same as R13		
R22	Same as R1		
R23	Same as R1		
R24	Same as R1		
R25	Same as R2		
R26	Same as R1		
R27	Same as R1		
R28	Same as R1		
R29	Same as R6		
R30	Same as R6		
R31	Same as R8		
R32	Same as R9		
R33	Same as R10		
R34	Same as R1		
R35	Same as R1		
R36	Same as R13		
R37	Same as R13		
R38	Same as R1		
R39	Same as R16		
R40	Same as R16		
R41	Same as R6		
R42	Same as R19		
R43	Same as R20		

Table 6-14. Input Amplifier Assembly A14, A15 Parts List

Circuit Ref.	Description	Manufacturer	Number
C1	Not listed		
C2	Capacitor, 80 pF ±5%, 500 V	Elmenco	03281380
C3	Capacitor, 4.7 μF ±20%, 25 V	Kemet	03287470
C4	Not listed		
C5	Capacitor, 0.01 μF ±20%, 50 V	Sprague	03281960
C6	Same as C5		
C7	Same as C5		
CR1	Transistor, S20266	FSC	26003501
CR2	Same as CR1		
Q1	Transistor, 2N4258	FSC	26014011
Q2	Same as Q1		
Q3	FET (selected), FD1256	Union Carbide	26004261
Q4	Not listed		
Q5	Transistor, 2N4275	FSC	26013140
Q6	Same as Q5		
R1	Resistor, fixed, 750 Ω ±5%, 1/8 W	AB	02395650
R2	Resistor, fixed, 1.3 k ±5%, 1/8 W	AB	02395710
R3	Same as R2		
R4	Same as R1		
R5	Resistor, fixed, 100 Ω ±5%, 1/8 W	AB	02395440
R6	Resistor, fixed, 1.6 k ±5%, 1/8 W	AB	02395730
R7	Same as R6		
R8	Resistor, fixed, 510 Ω ±5%, ¼ W	Amperex	02040411
R9	Resistor, fixed, 1 M ±5%, ¼ W	AB	02355330
R10	Resistor, fixed, 100 k ±5%, ¼ W	Amperex	02040961
R11	Resistor, fixed, 10 Ω ±5%, 1/8 W	AB	02395200
R12	Resistor, fixed, 10 k ±5%, 1/8 W	AB	02395920
R13	Resistor, fixed, 200 ±5%, 1/8 W	AB	02395510
R14	Same as R13		
R15	Same as R11		
R16	Same as R12		
R17	Resistor, variable, 2 k, 1 W	Amphenol	01095370
R18	Resistor, variable, 10 M ±5%, 1/8 W	AB	02396640
R19	Resistor, variable, 2.7 k ±5%, 1/8 W	AB	02395780
R20	Resistor, variable, 1 M ±5%, 1/8 W	AB	02396400

Table 6-15. Oscillator Assembly A16 Parts List

Circuit Ref.	Description	Manufacturer	Number
A16	Oscillator, 1 MHz	Bliley	89019881
C1	Capacitor, fixed, 0.047 μF ±10%, 250 V	Amperex	03281080
R1	Resistor, fixed, 2.4 k ±5%, ¼ W	Amperex	02040570
	Oscillator, Support		35077691
	Oscillator, Special		89019881
	Tube, Socket, Octal		09065230

Table 6-16. Diode Matrix A6 Assembly Parts List

Circuit Ref.	Description	Manufacturer	Number
CR1	Diode, FD200	FSC	26011850
CR2	Same as CR1		
CR3	Same as CR1		
CR4	Same as CR1		
CR5	Same as CR1		
CR6	Same as CR1		
CR7	Same as CR1		
CR8	Same as CR1		
CR9	Same as CR1		
CR10	Same as CR1		
CR11	Same as CR1		
CR12	Same as CR1		
Q1	Transistor, S20364	FSC	26004021
Q2	Same as Q1		
R1	Resistor, fixed, 16 kΩ ±5%, ¼ W	Amperex	02040771
R2	Same as R1		
R3	Same as R1		
R4	Same as R1		
R5	Same as R1		
R6	Same as R1		
R7	Same as R1		
R8	Same as R1		
R9	Same as R1		
R10	Resistor, fixed, 13 kΩ ±5%, ¼ W	Amperex	02040751
R11	Resistor, fixed, 33 kΩ ±5%, ¼ W	Amperex	02040841
R12	Resistor, fixed, 2 kΩ ±5%, ¼ W	Amperex	02040551
R13	Same as R12		

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